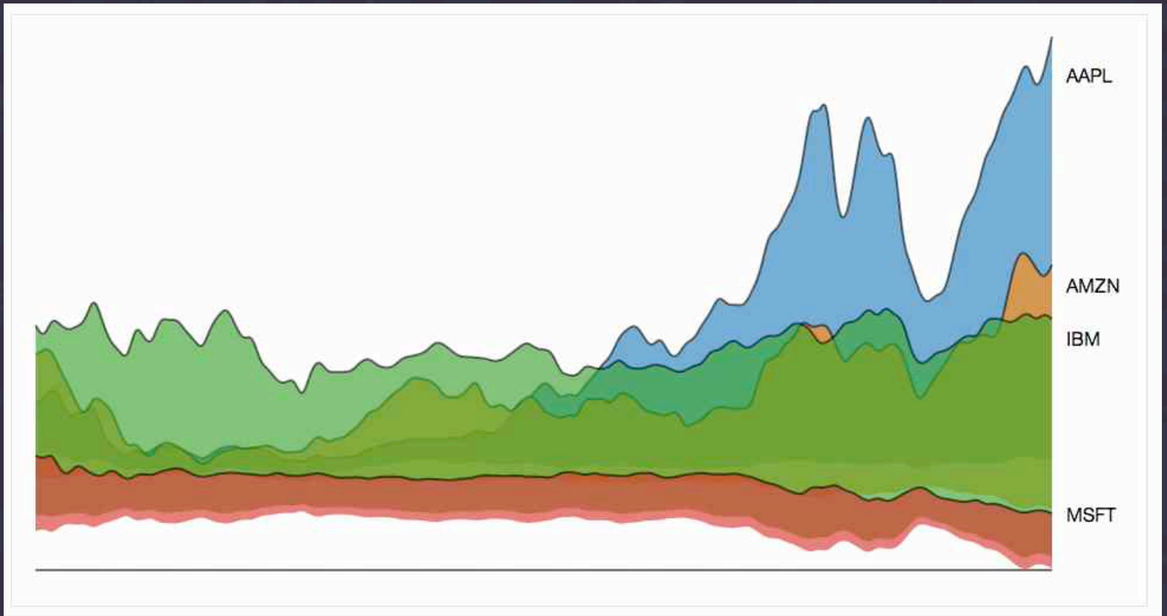
Explore New Data Dimensions
w/ Apex + Open Source Graphing Libs



David Mann | @ba6dotus | http://ba6.us

TOPICS

- Why do we Create Visualizations?
- Moving Beyond the Defaults w/examples
- Extend Apex with F/OSS Libraries
- 3 Popular JavaScript F/OSS Graphing Tools
- Integrating JavaScript Libraries With Apex
- Let’s Build a Visualization in Apex

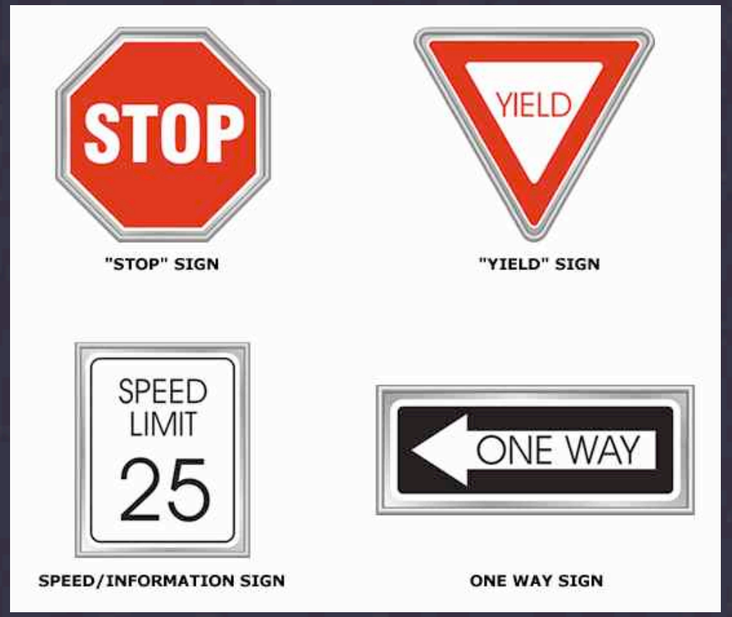
BIO

- Graphic Arts Background
- Developer and DBA
- I Like Shiny Things

- Work - DBI Consulting
  - Architecture Focus
  - Analysis Opportunities

DBI CONSULTING

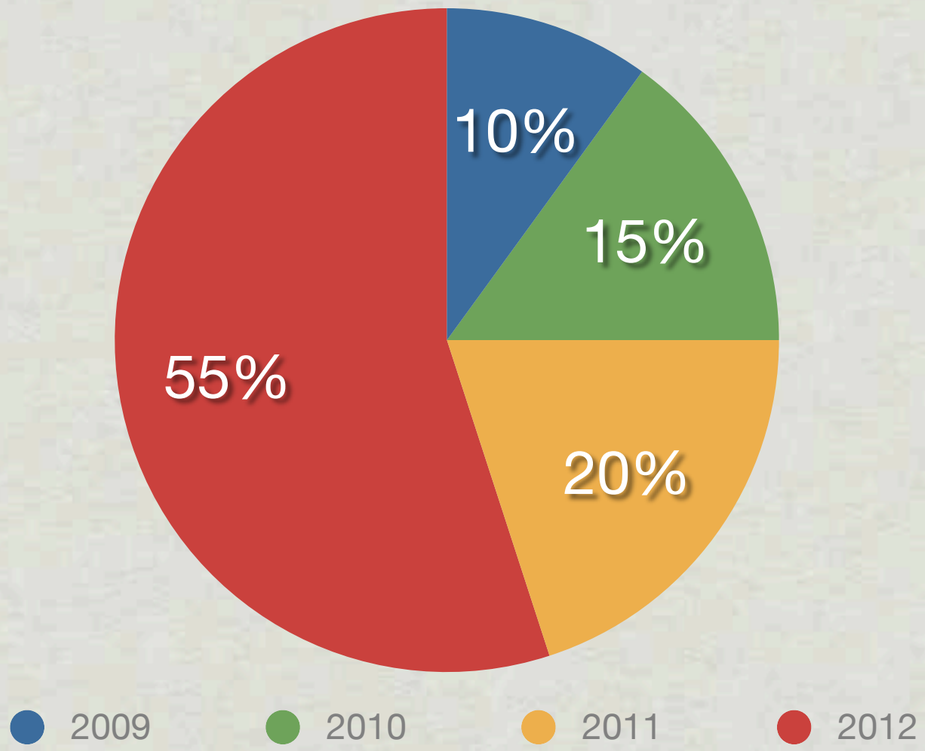
lifescale analytics

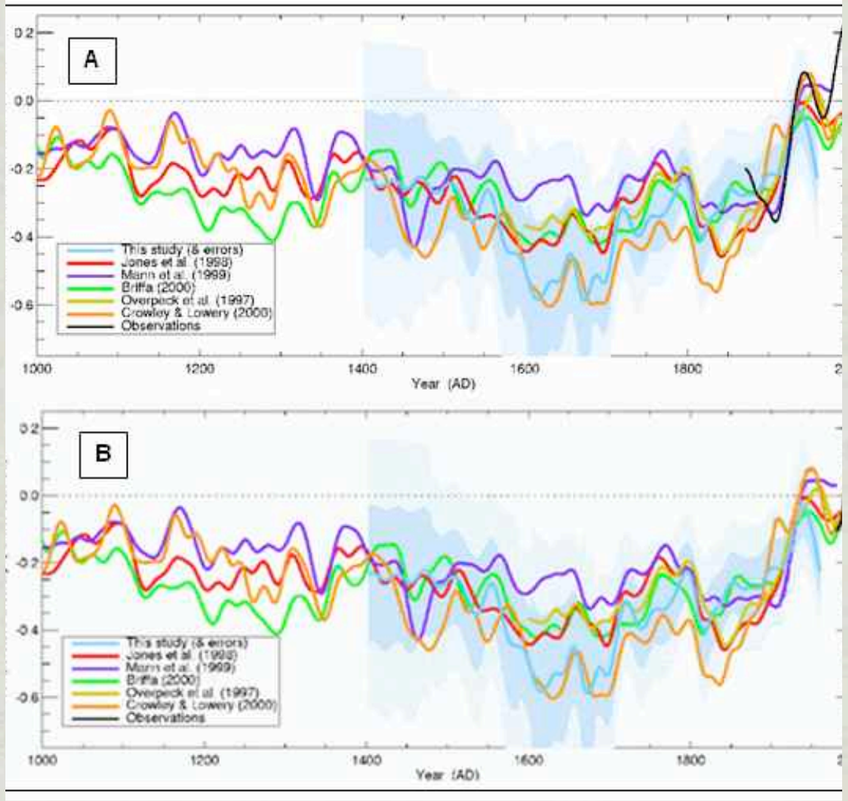


WHY DO WE CREATE VISUALIZATIONS?

QUALITIES OF A GOOD VISUALIZATION

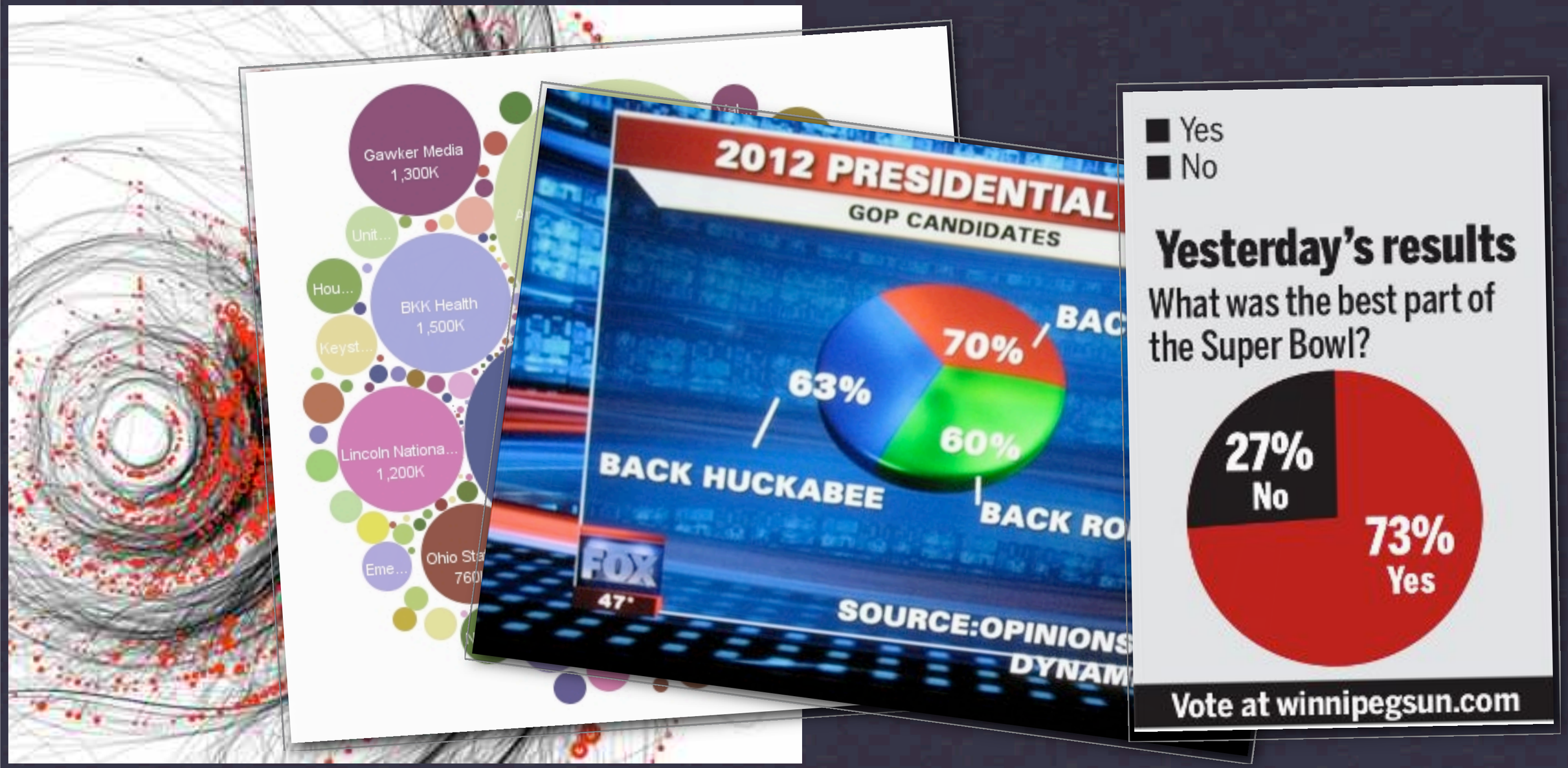
Recognizable + Readable = Effective





CHALLENGES

- Distill the essence of a data set into a clear visual representation
- Mapping data to visualizations
- Move beyond default graphing options when it makes sense
- Construction and Implementation details
- Stimulate Critical Thinking - Alternate ways of relating to data
- Iterate - Don’t be afraid to fail!



SOME VISUALIZATIONS ARE NOT GOOD

MOVING BEYOND THE DEFAULTS - SUBTOPICS

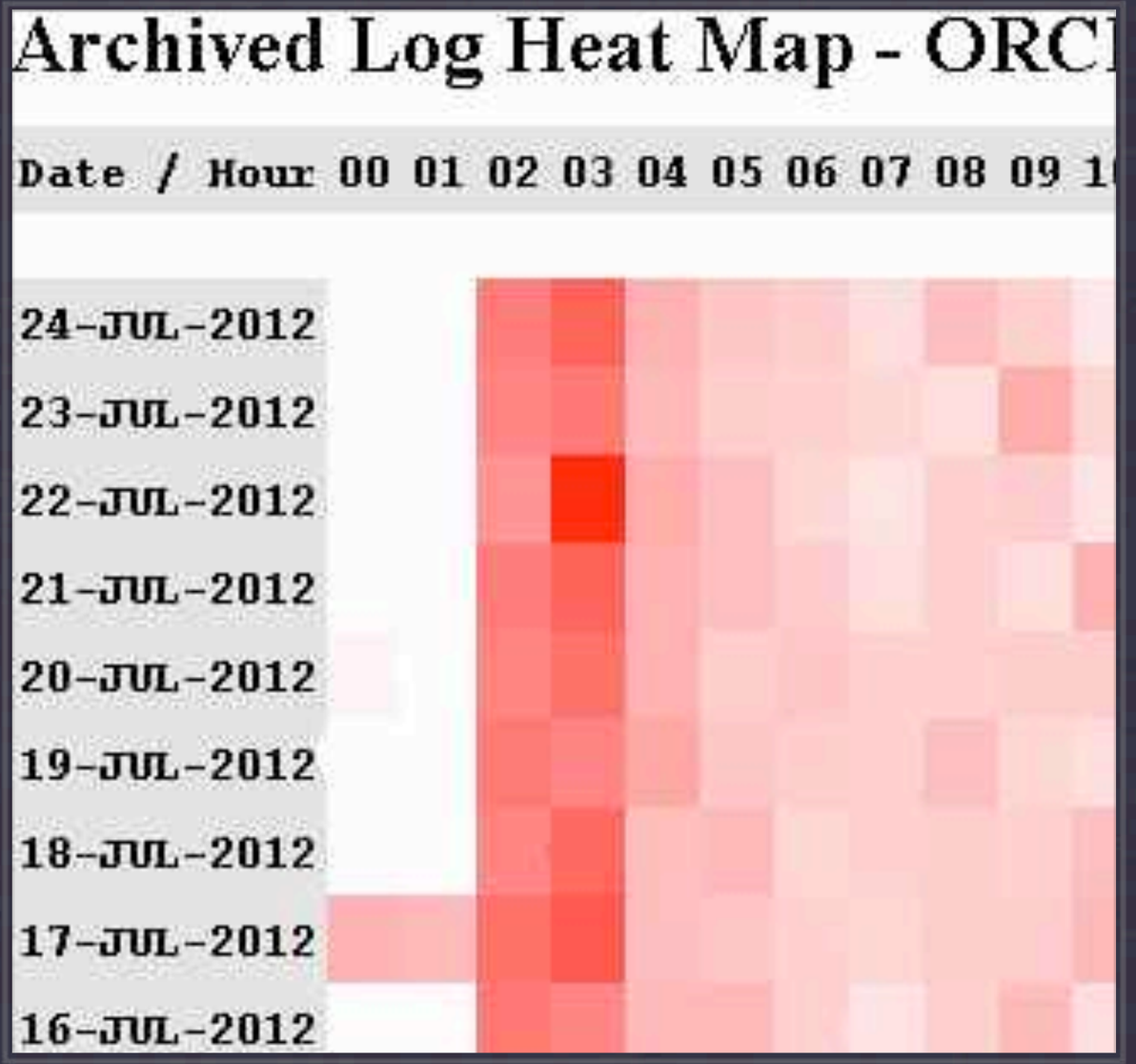
- Apex Defaults
- Levels of Abstraction
- Adding More variables into the Mix
- Alternate Filtering/Aggregation
- Spatial Relationships
- Temporal Relationships
- Combinations of above

APEX DEFAULTS

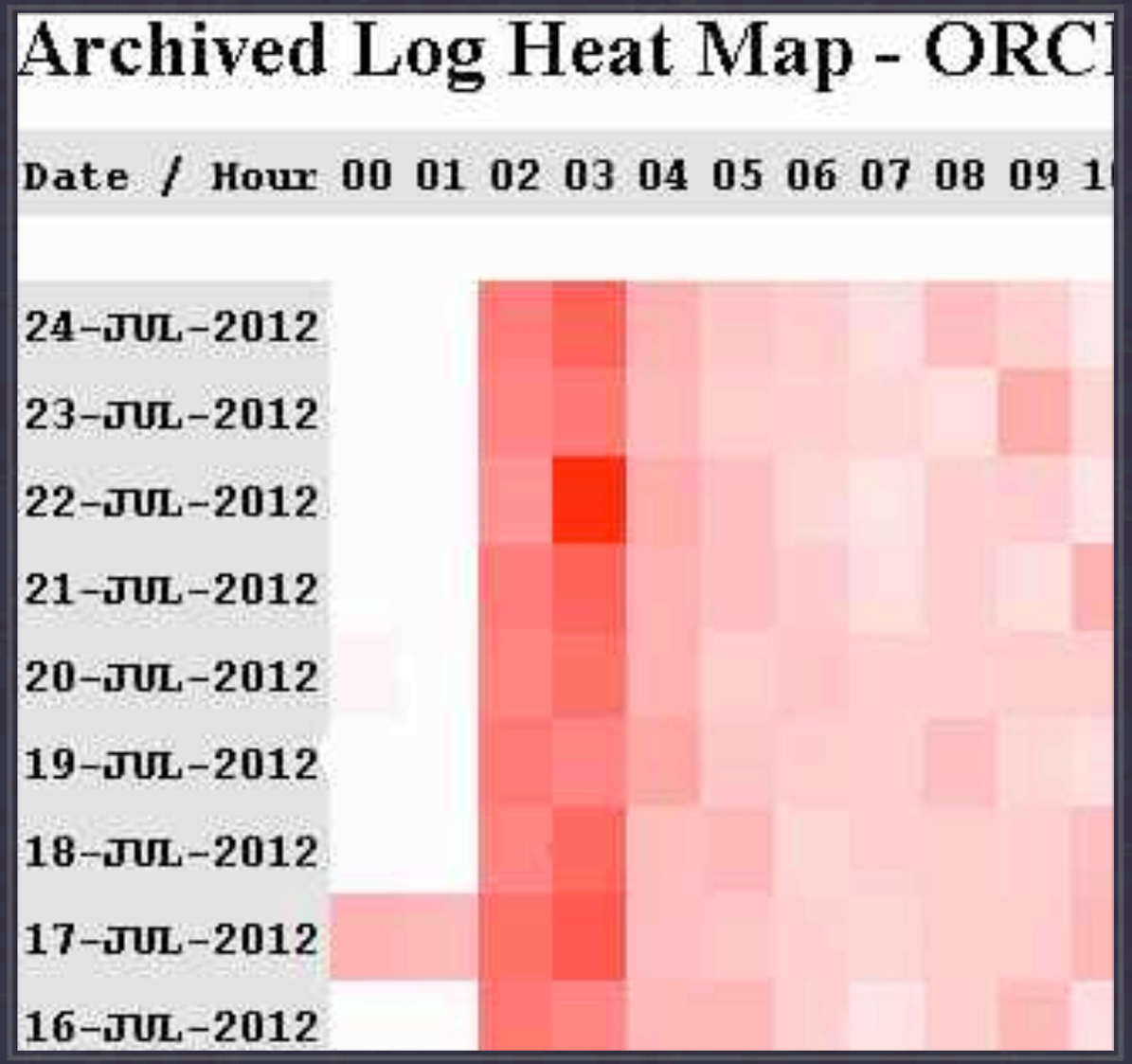
Archived Log Heat Map - ORC

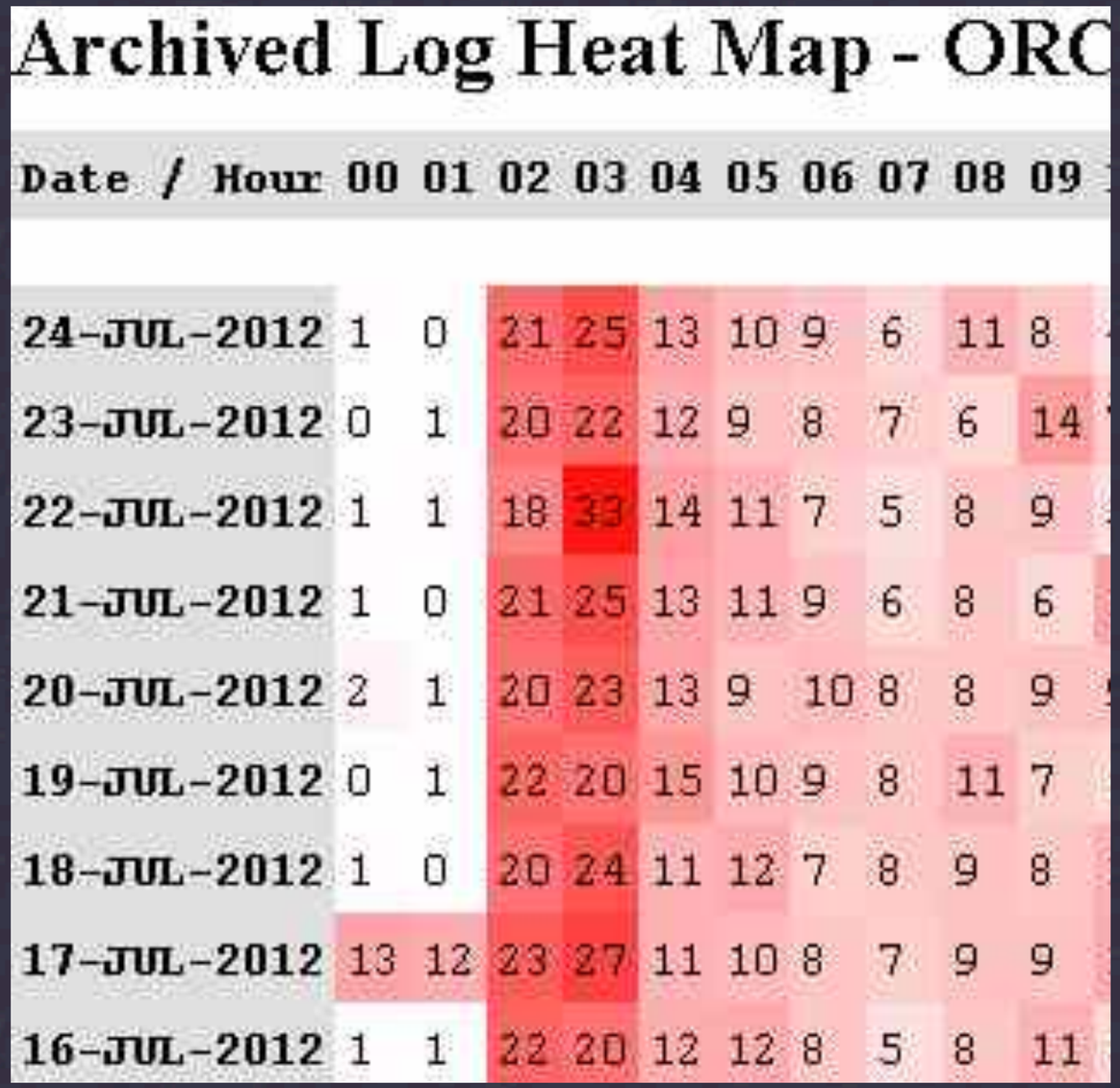
Date / Hour	00	01	02	03	04	05	06	07	08	09	1
24-JUL-2012	1	0	21	25	13	10	9	6	11	8	4
23-JUL-2012	0	1	20	22	12	9	8	7	6	14	7
22-JUL-2012	1	1	18	33	14	11	7	5	8	9	5
21-JUL-2012	1	0	21	25	13	11	9	6	8	6	1
20-JUL-2012	2	1	20	23	13	9	10	8	8	9	9
19-JUL-2012	0	1	22	20	15	10	9	8	11	7	6
18-JUL-2012	1	0	20	24	11	12	7	8	9	8	1
17-JUL-2012	13	12	23	27	11	10	8	7	9	9	1
16-JUL-2012	1	1	22	20	12	12	8	5	8	11	6

Archived Log Heat Map - ORC



LEVELS OF ABSTRACTION - TRY 1 & 2

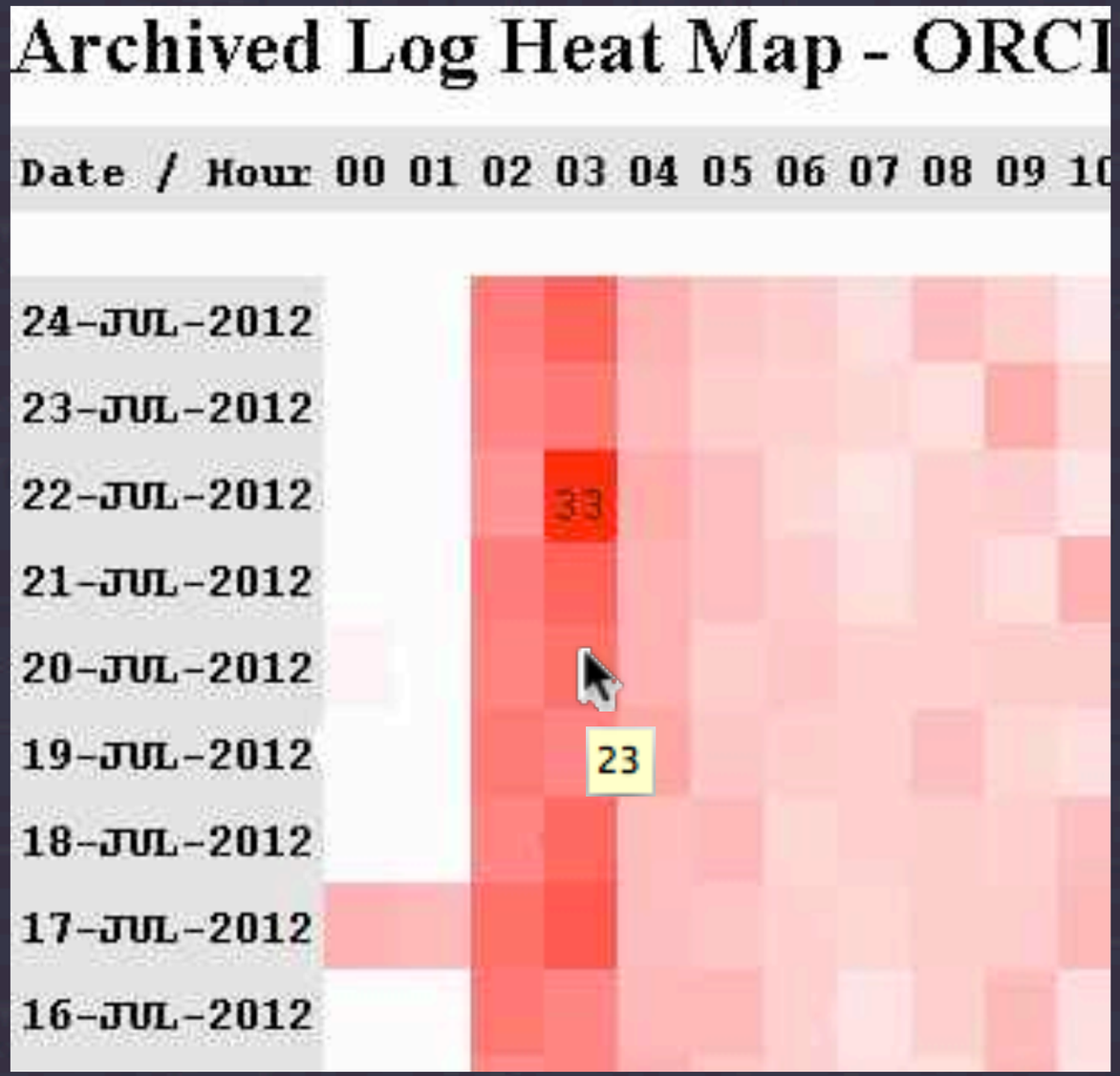




LEVELS OF ABSTRACTION - TRY 2 & 3

Archived Log Heat Map - ORCL

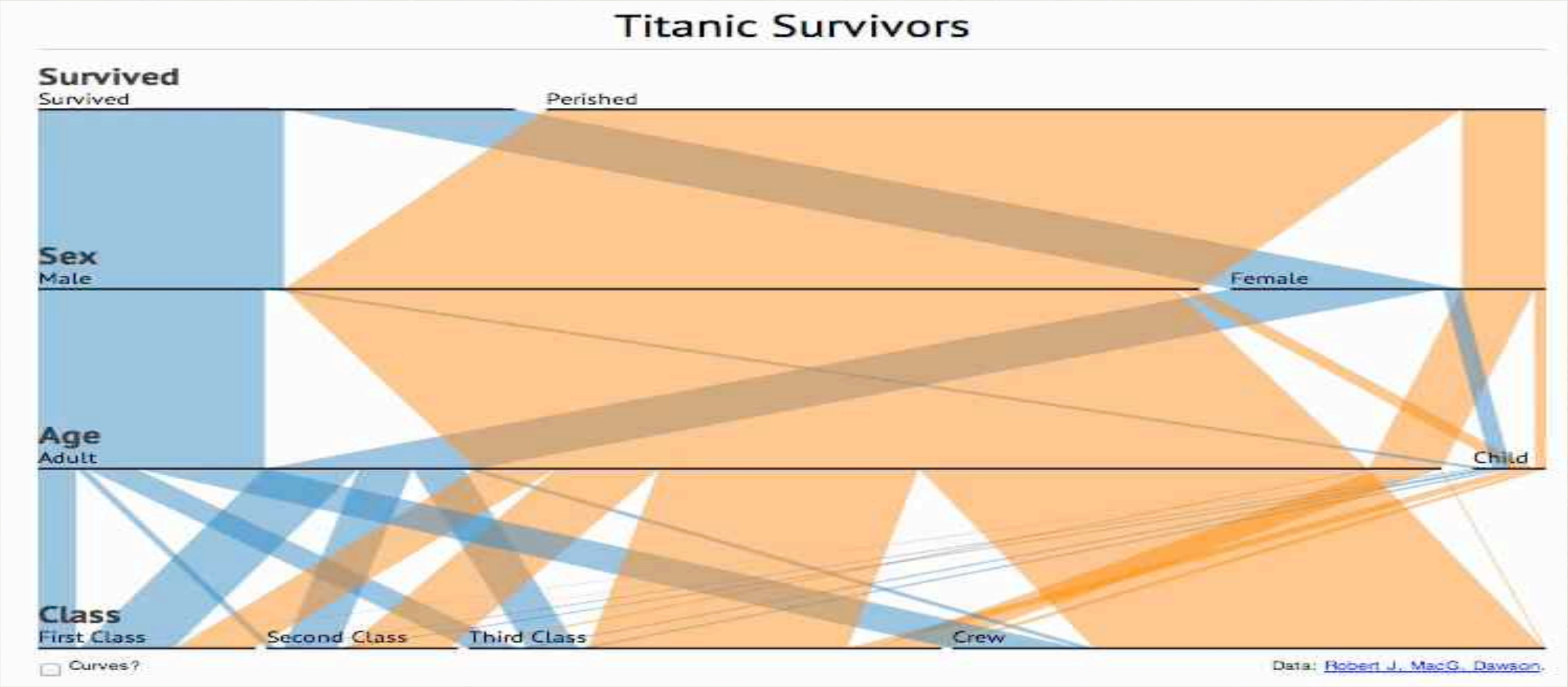
Date / Hour	00	01	02	03	04	05	06	07	08	09	10
24-JUL-2012	1	0	21	25	13	10	9	6	11	8	4
23-JUL-2012	0	1	20	22	12	9	8	7	6	14	7
22-JUL-2012	1	1	18	33	14	11	7	5	8	9	5
21-JUL-2012	1	0	21	25	13	11	9	6	8	6	13
20-JUL-2012	2	1	20	23	13	9	10	8	8	9	9
19-JUL-2012	0	1	22	20	15	10	9	8	11	7	6
18-JUL-2012	1	0	20	24	11	12	7	8	9	8	11
17-JUL-2012	13	12	23	27	11	10	8	7	9	9	12
16-JUL-2012	1	1	22	20	12	12	8	5	8	11	6



LEVELS OF ABSTRACTION - TRY 3 & 4

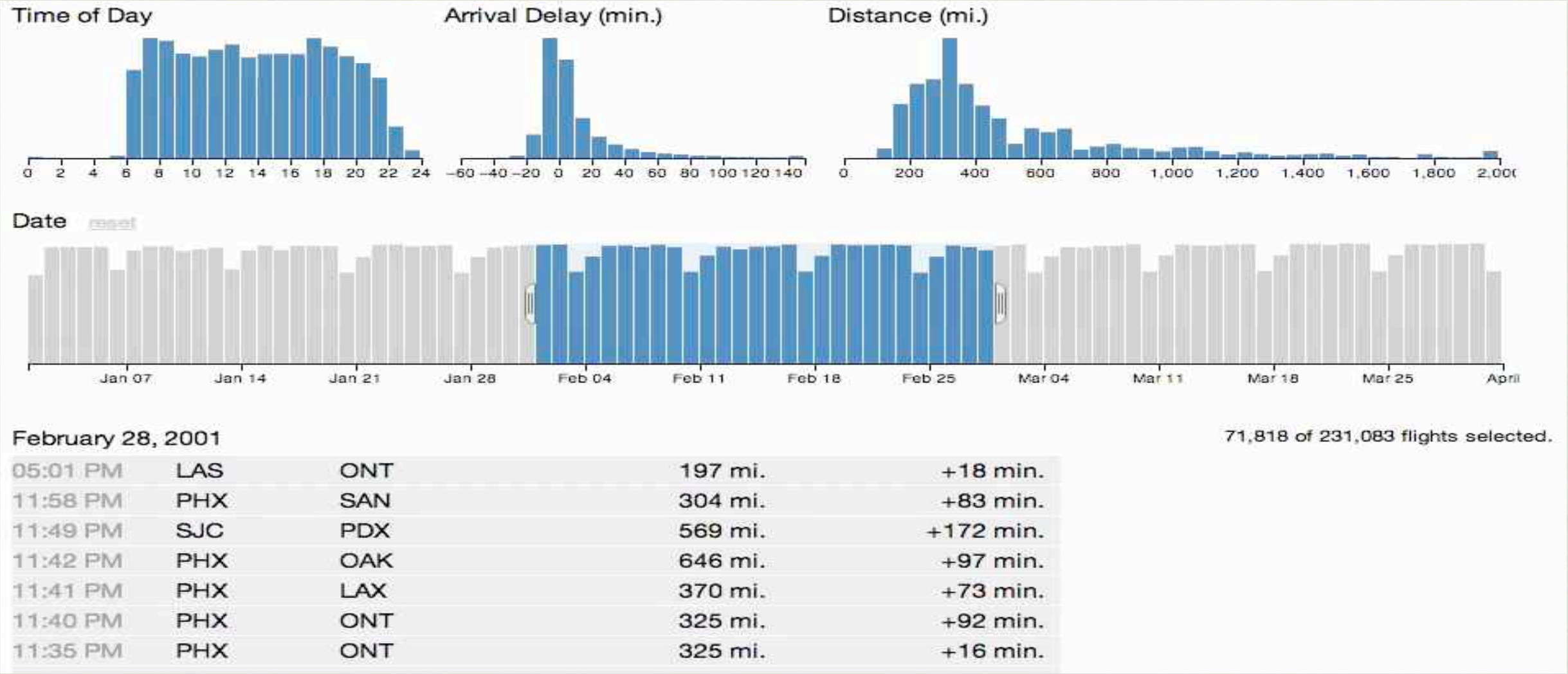
LINK TO SOURCE

MORE VARIABLES - PARALLEL SETS



http://www.jasondavies.com/parallel-sets/

INTERACTIVE FILTERING



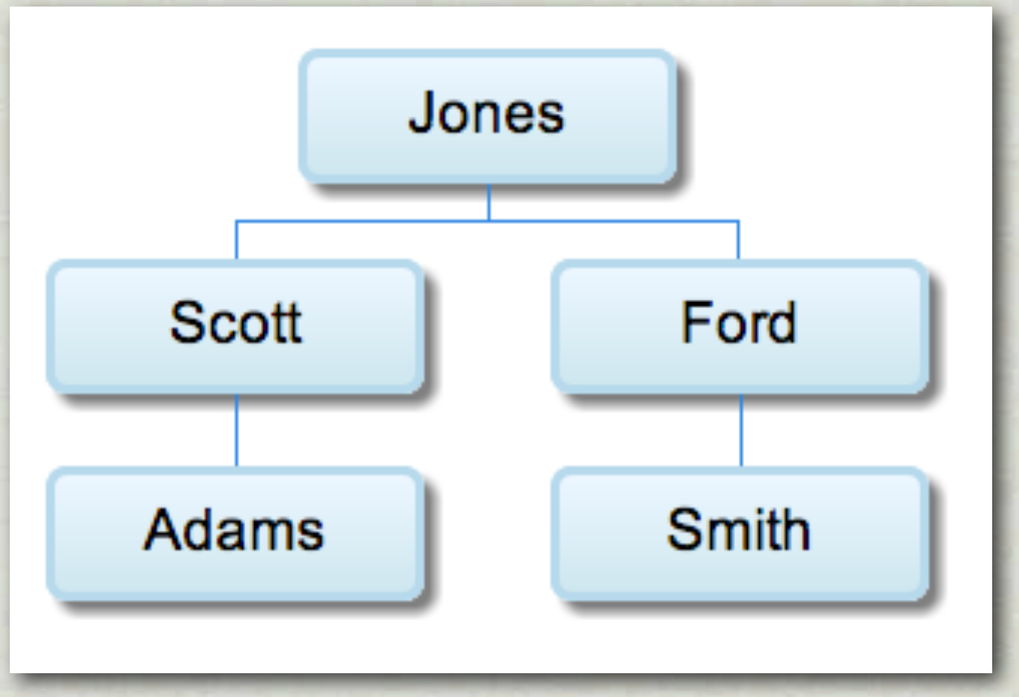
Cross Filter - http://square.github.com/crossfilter/

RELATIONSHIPS & RELATIVE POSITIONS

- Hierarchies - Parent/Child
- Network Relations
  - Nodes/Edges
  - Directed Graphs
- Map Projections

HIERARCHIES

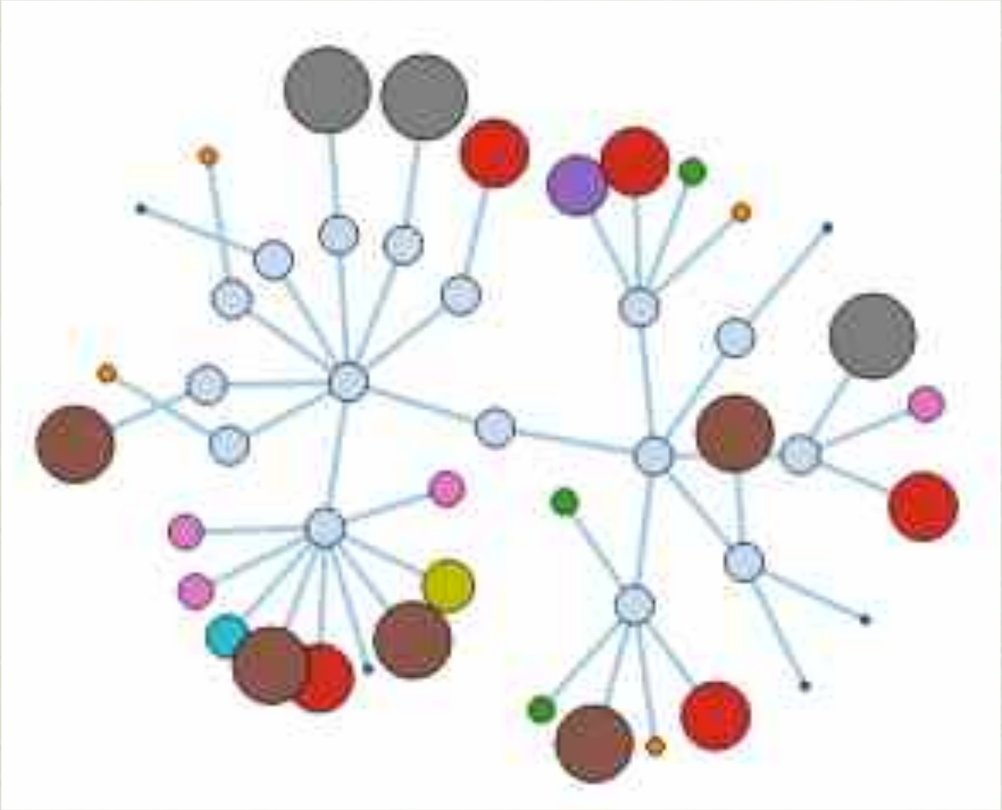
```
select lpad(' ',level*2,' ')||ename ename,
       empno, mgr
       from emp
       START WITH ENAME='JONES'
       CONNECT BY PRIOR EMPNO = MGR;

ENAME                 EMPNO        MGR
--------------- ---------- ----------
    JONES             7566       7839
      SCOTT           7788       7566
        ADAMS         7876       7788
      FORD            7902       7566
        SMITH         7369       7902

5 rows selected.
```



LINK TO SOURCE

ADJACENCY RELATIONSHIPS

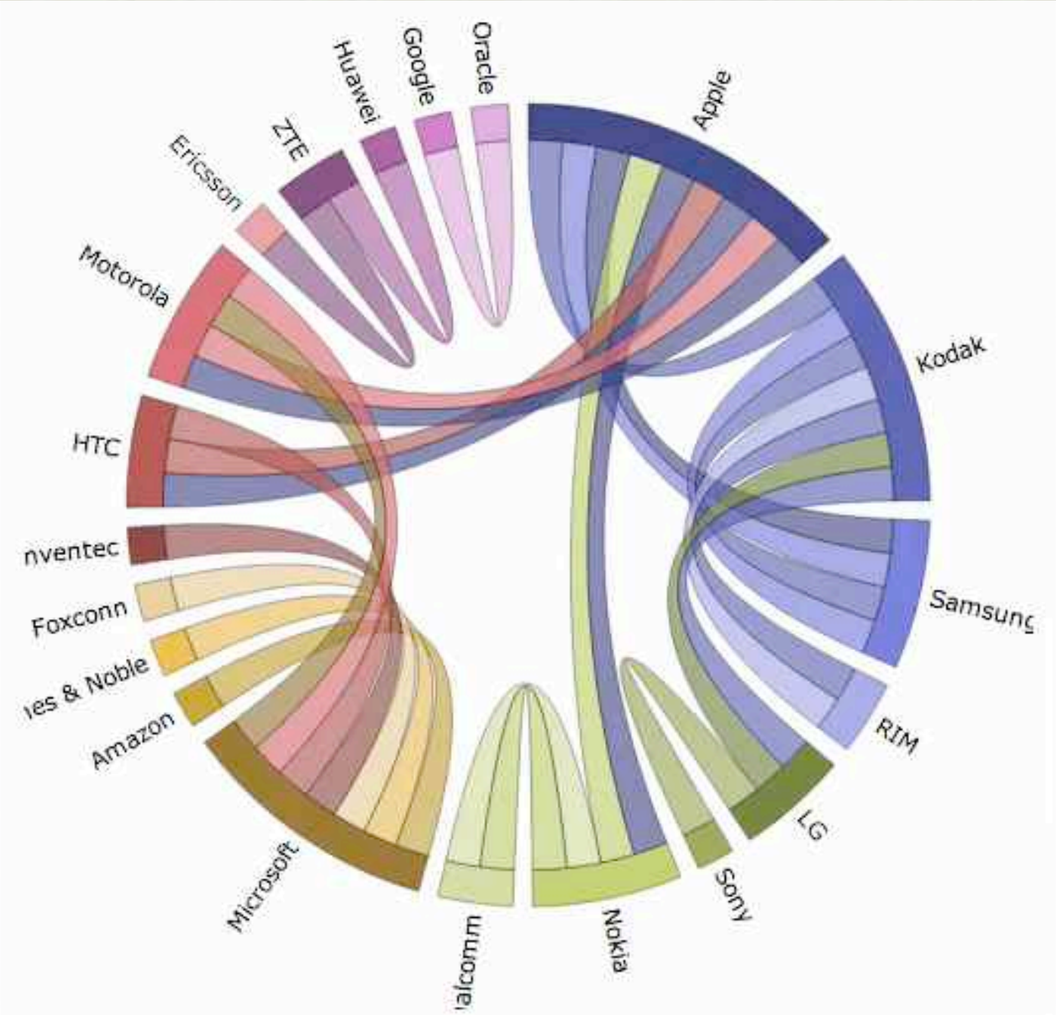
- Nodes connected by edges
  - Nodes show endpoints
    - Can have attributes like Gender, Age, Weight, Volume
  - Edges show connections
    - Can also have attributes like Force, Direction, Connection Date, Frequency of Contact, Direction of Relationship



http://dl.dropbox.com/u/14196218/Share/d3ForceIntegrations.html
http://evening-mountain-5731.herokuapp.com/index.html

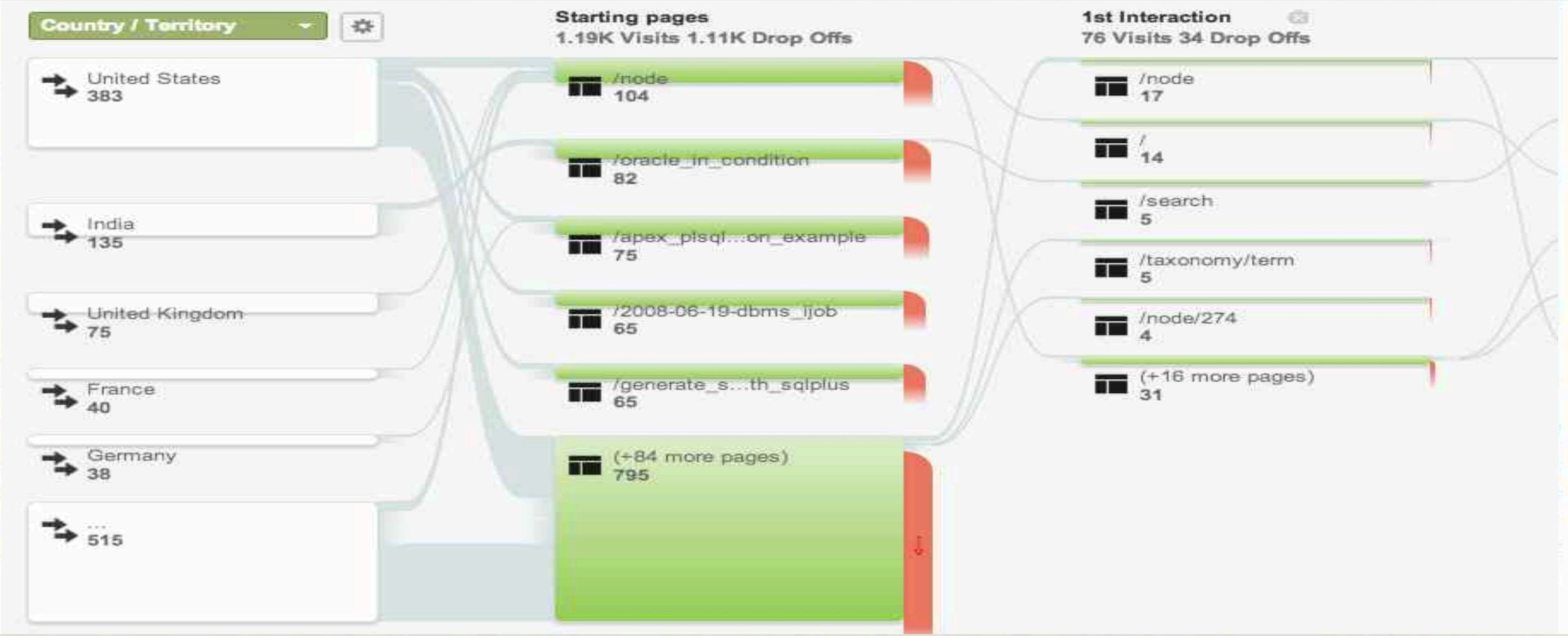
ADJACENCY RELATIONSHIPS

- Chord Diagram
  - Directed Links between peer nodes
  - Involved in more relationships, more radial space taken



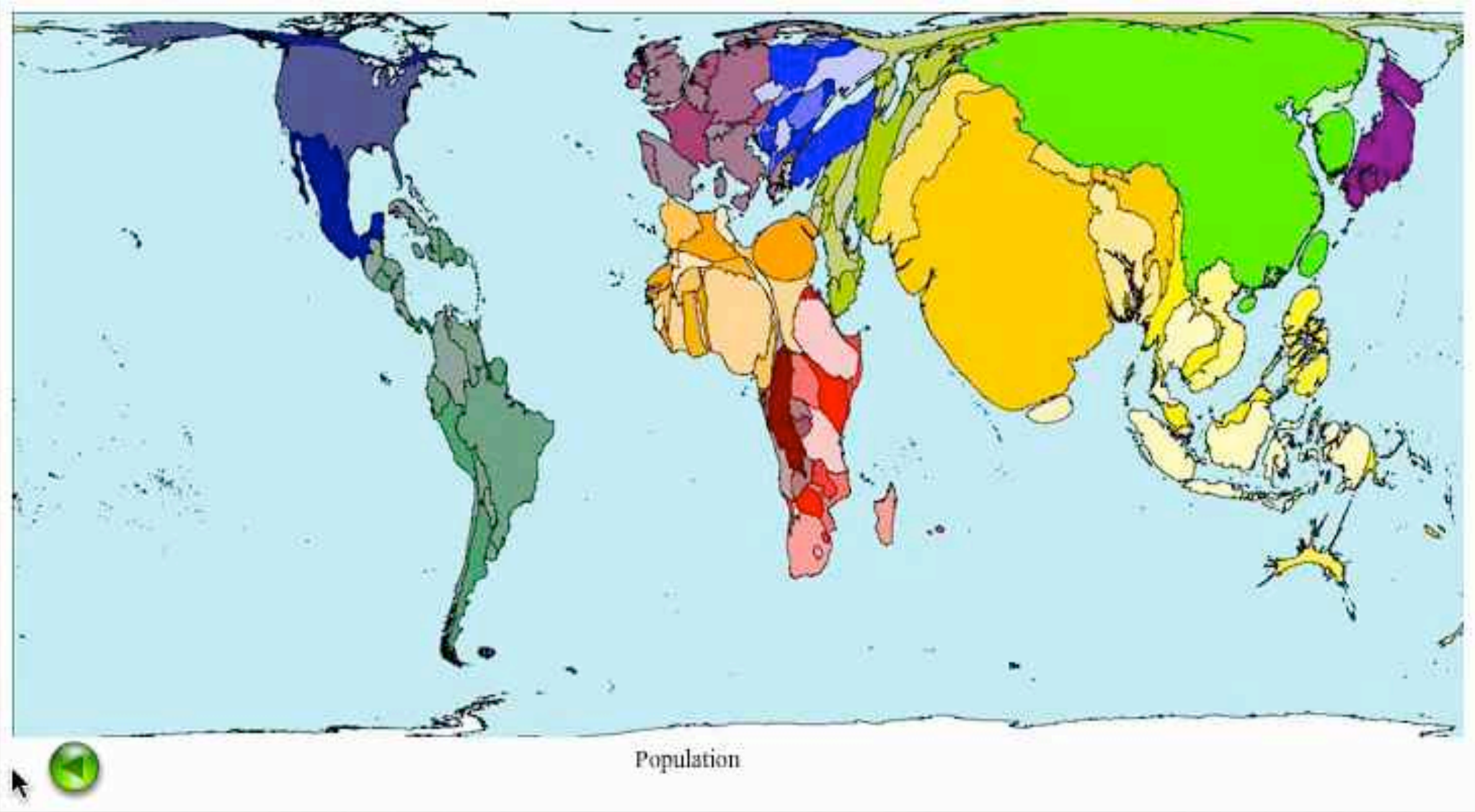
http://www.jasondavies.com/mobile-lawsuits/

PARALLEL SETS - SANKEY DIAGRAM



http://nickrabinowitz.com/projects/d3/alluvial/alluvial-dynamic.html

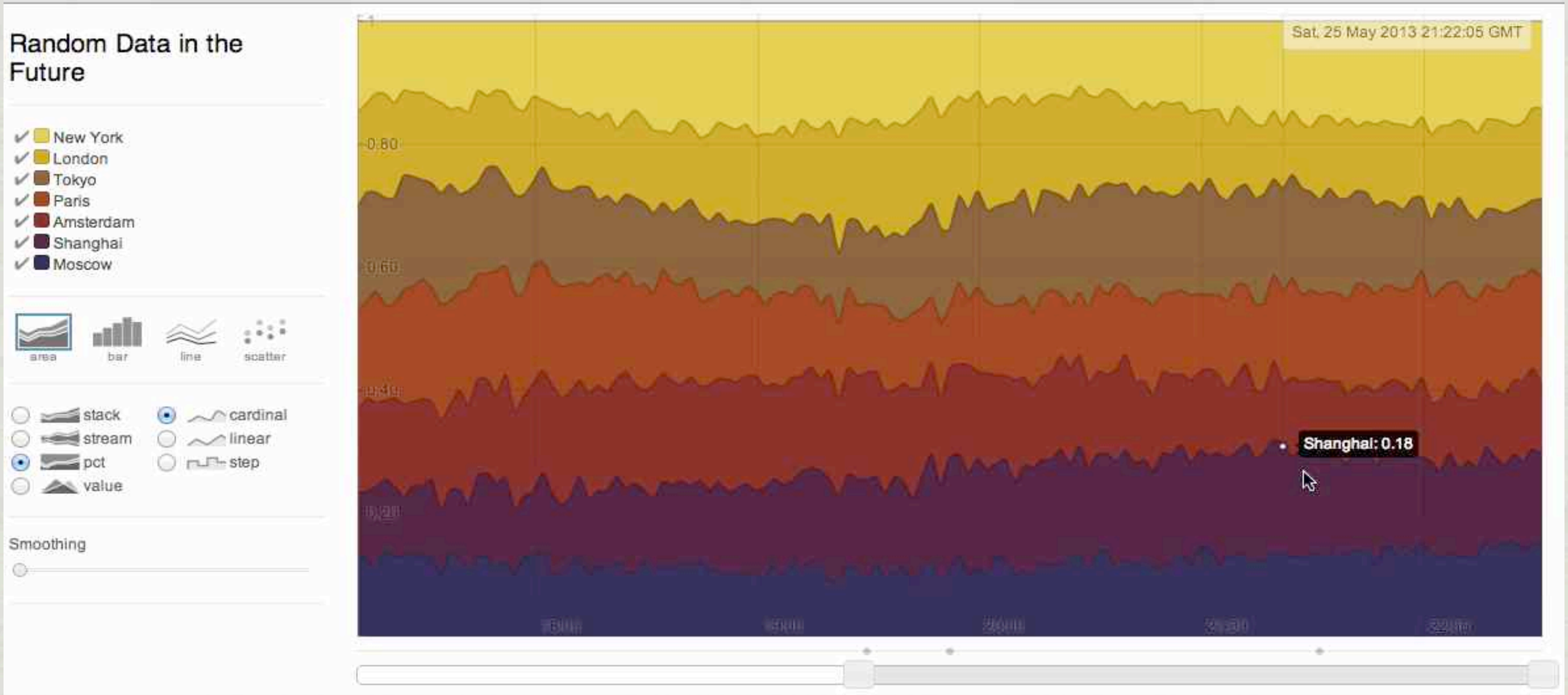
MAP PROJECTIONS



EX. 1

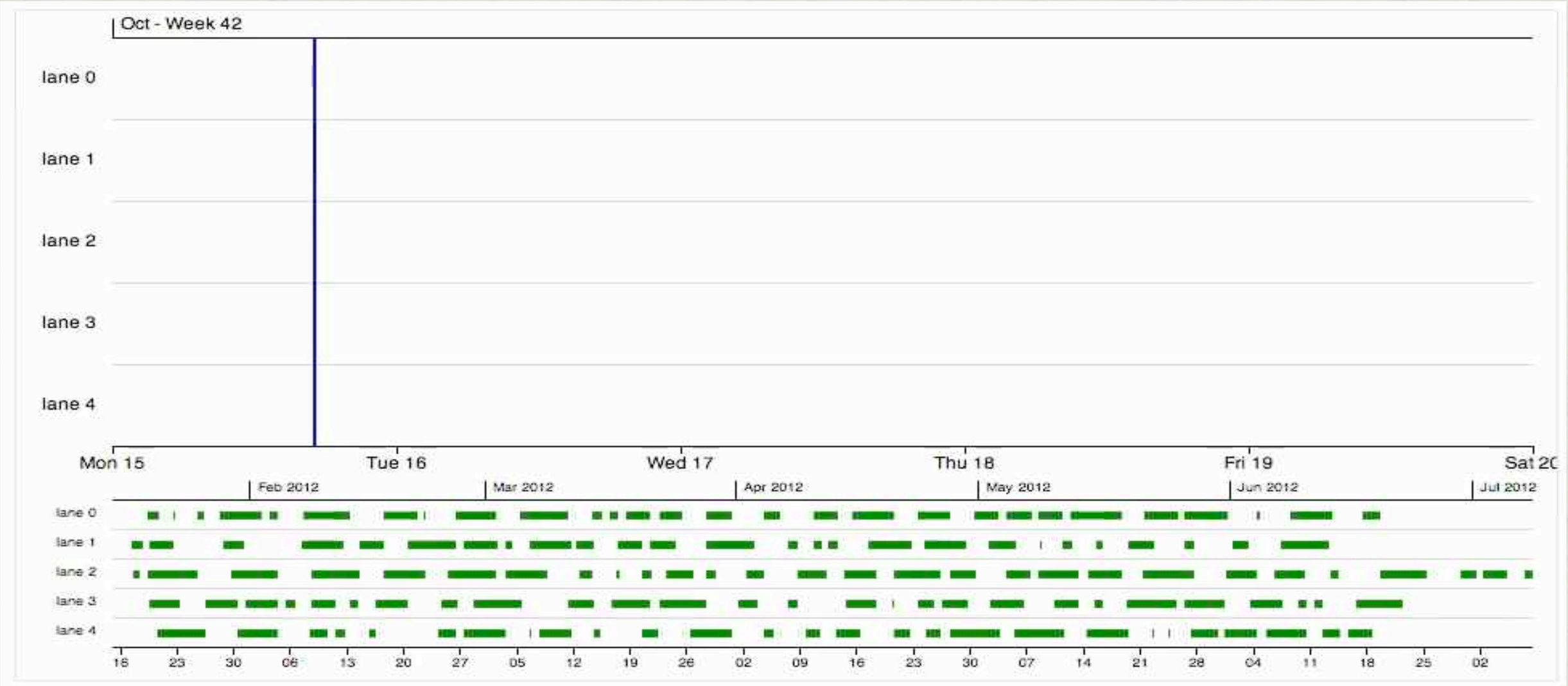
EX. 2

TEMPORAL RELATIONSHIPS



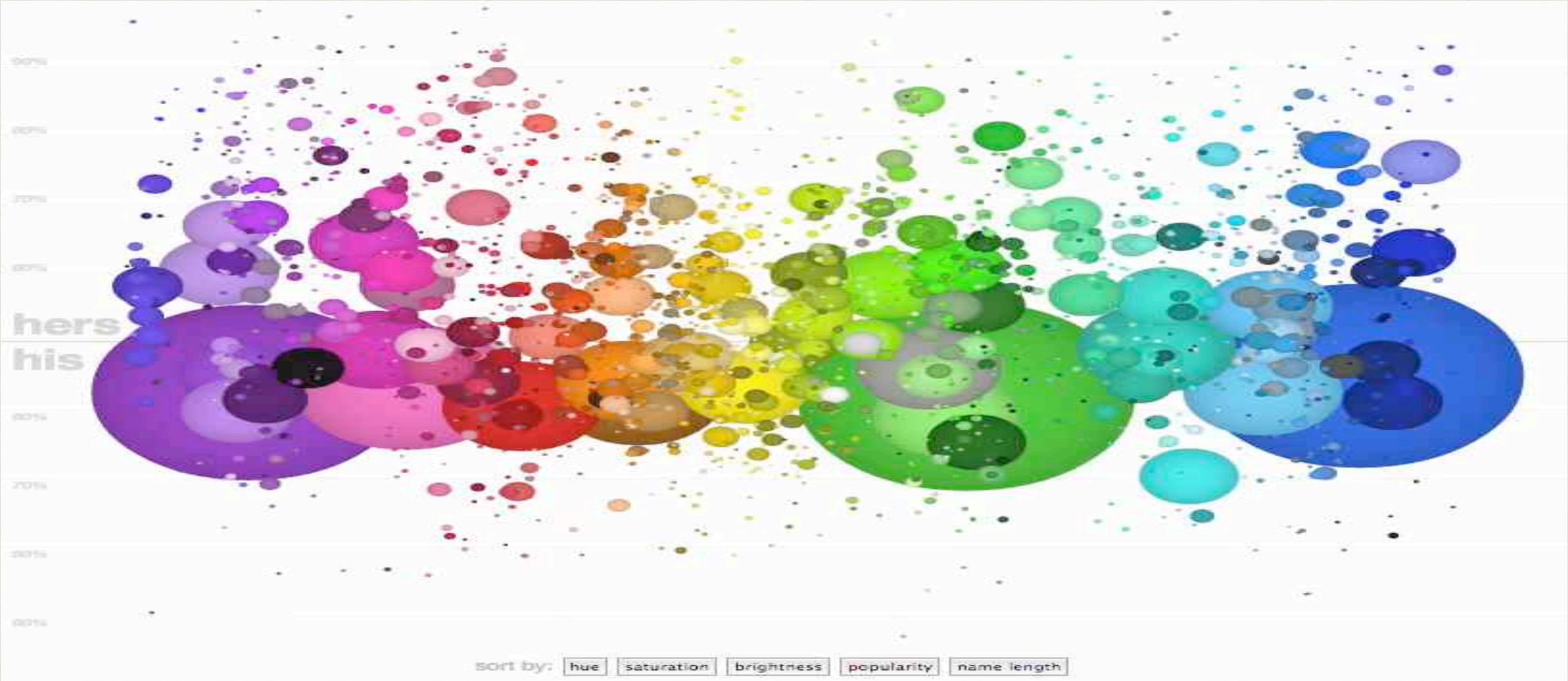
RICKSHAW.JS

SWIMLANE



http://bl.ocks.org/1962173

COMBINING RELATIONSHIPS



http://www.datapointed.net/visualizations/color/men-women-color-names-d3/

EXTEND APEX WITH F/OSS LIBRARIES

BUY / BUILD / ADAPT

- VS -

HOW FREE IS FREE?

How is your relationship with JavaScript?

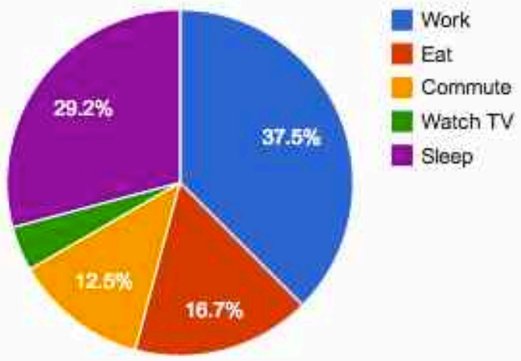
- Rocky?
- Much more stable and predictable lately
- Dev Console is your friend
- webplatform.org
- JavaScript: “The Good Parts”

POPULAR F/OSS GRAPHING OPTIONS

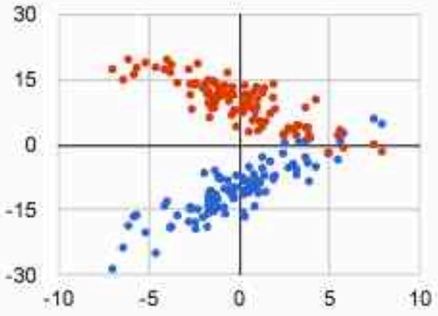
- Google Chart API
- Javascript Infovis Toolkit
- D3 - Data Driven Documents
  + 'Helper' libraries

GOOGLE CHARTS

Pie Chart



Scatter Chart



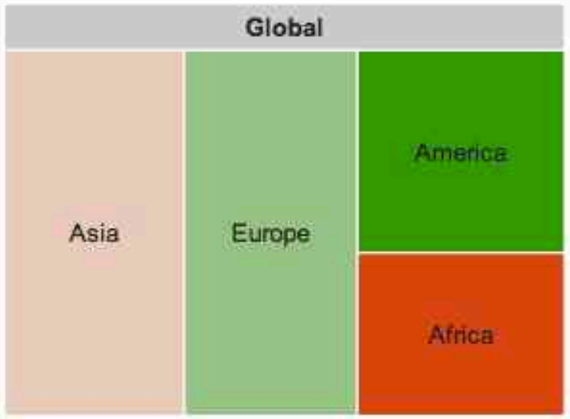
Gauge

Geo Chart

Table

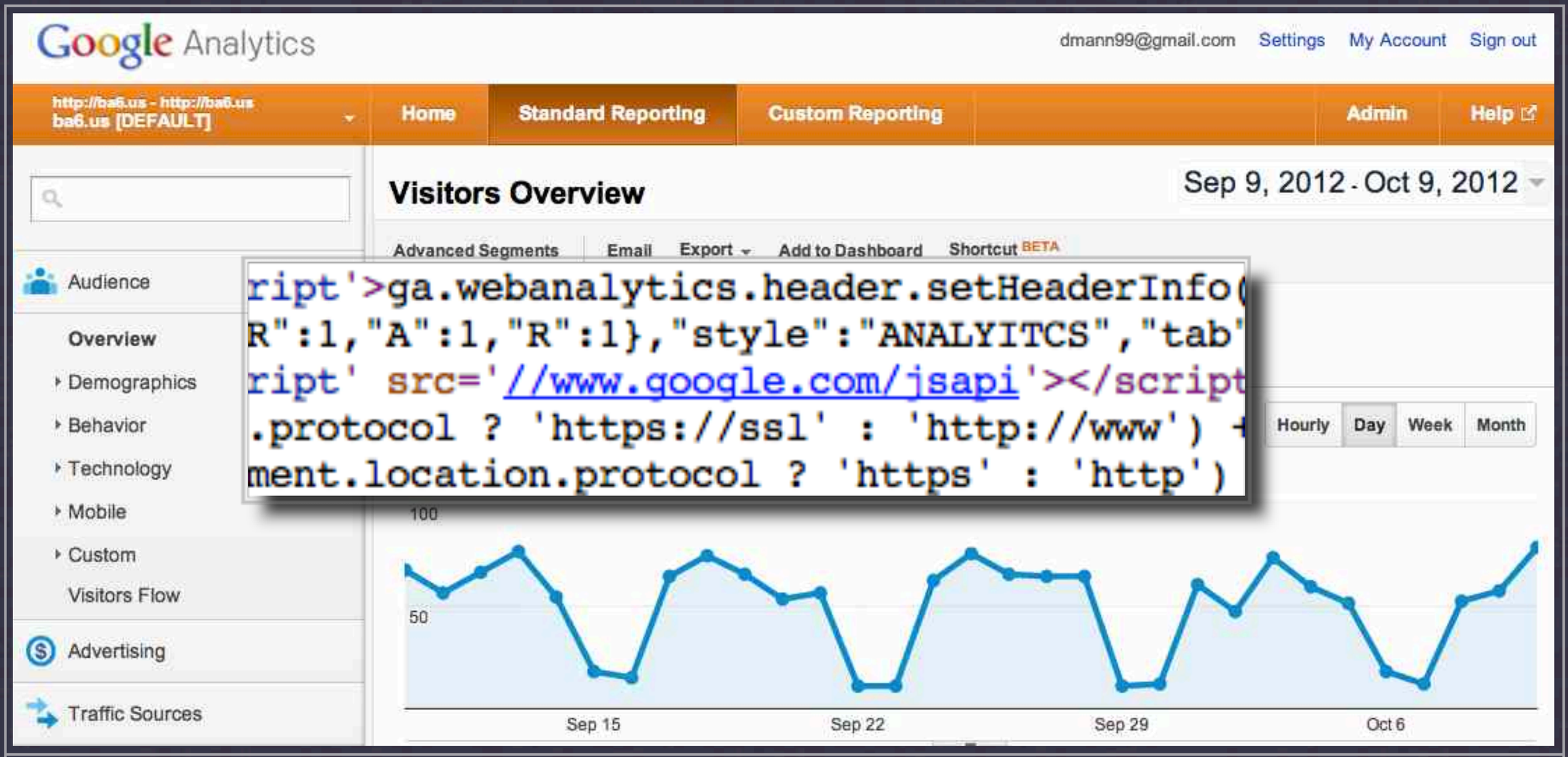
	Name	Salary	Full Time
1	Mike	$10,000	✓
2	Jim	$8,000	✗
3	Alice	$12,500	✓
4	Bob	$7,000	✓

Treemap



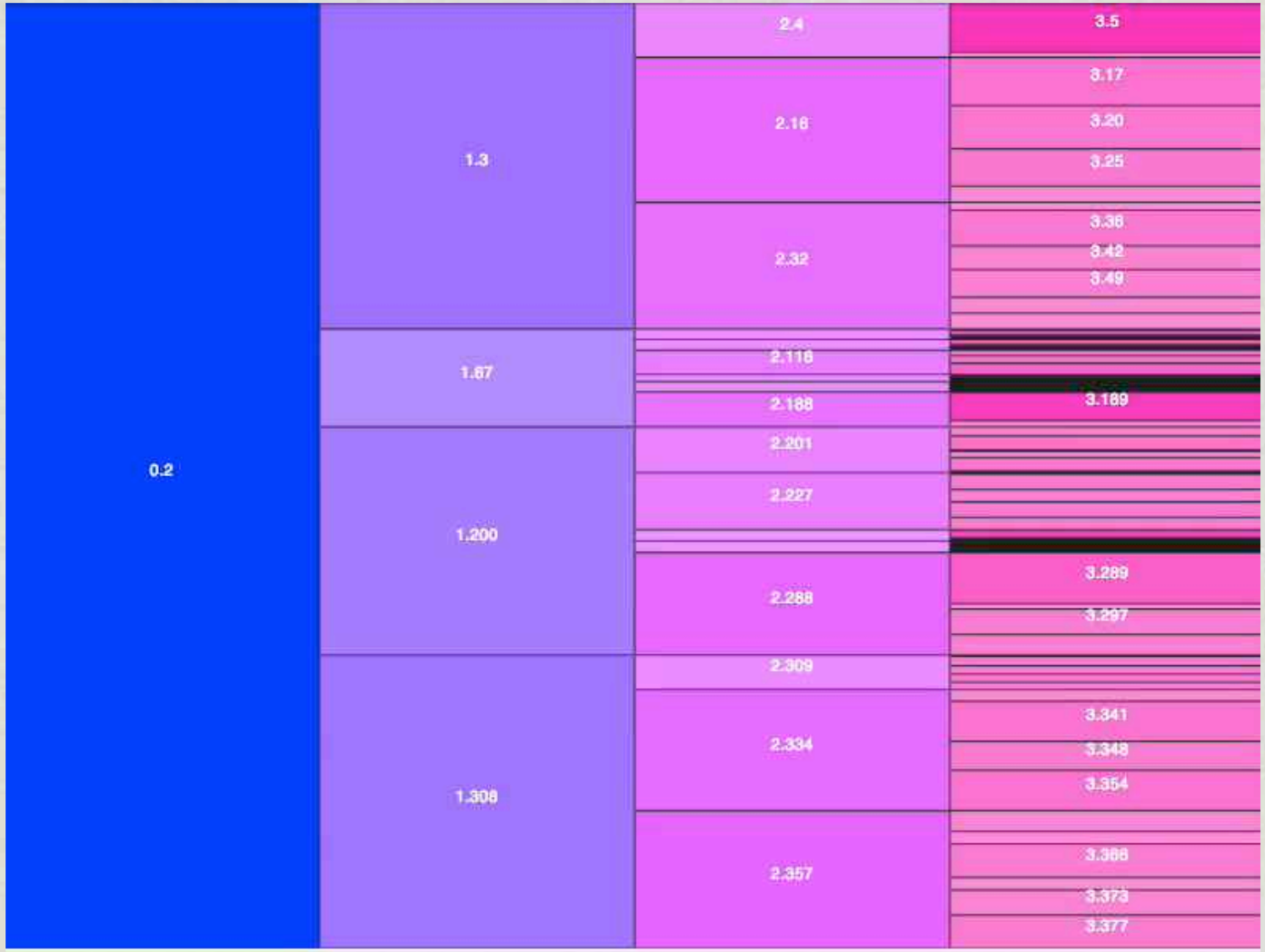
GOOGLE CHARTS PROS + CONS

- Pros
  - Easy to get started with the “Playground”
  - Excellent documentation & Examples
  - Begin with defaults, customize with events if needed
- Cons
  - Google Whims
  - Dependency on their servers



GOOGLE EATS THEIR OWN DOG FOOD

JavaScript Infovis Toolkit

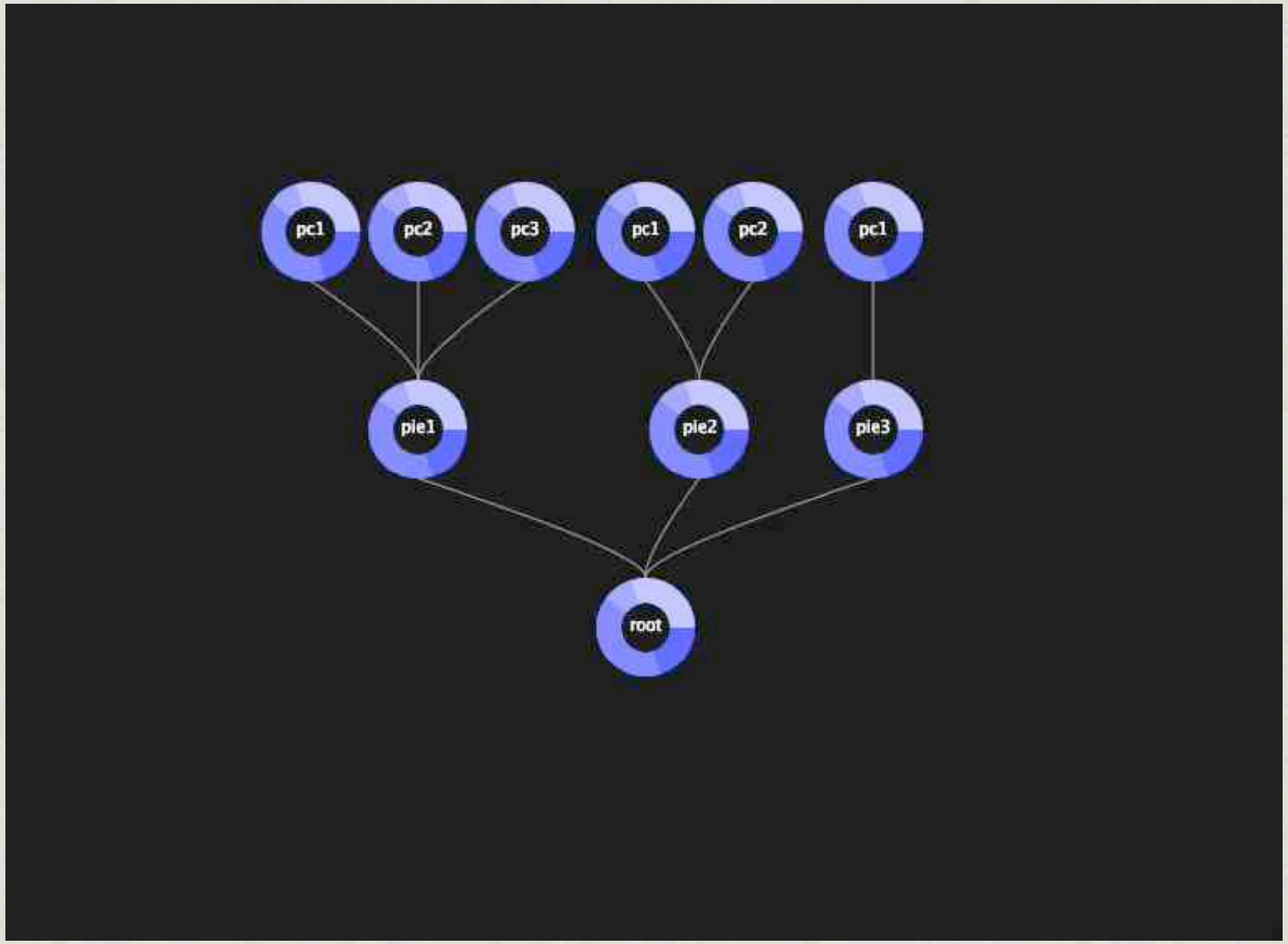


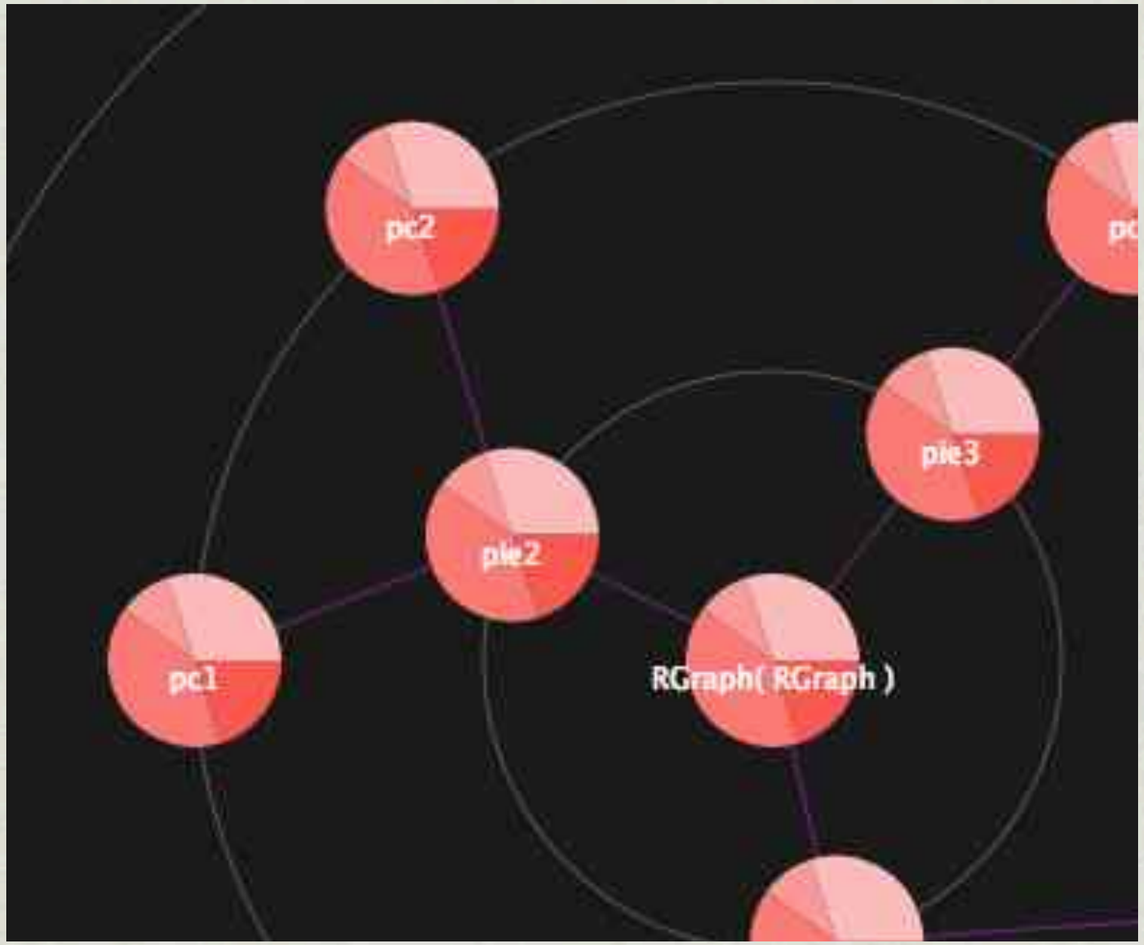
HTTP://PHILOGB.GITHUB.COM/JIT/DEMOS.HTML

JIT Pros + Cons

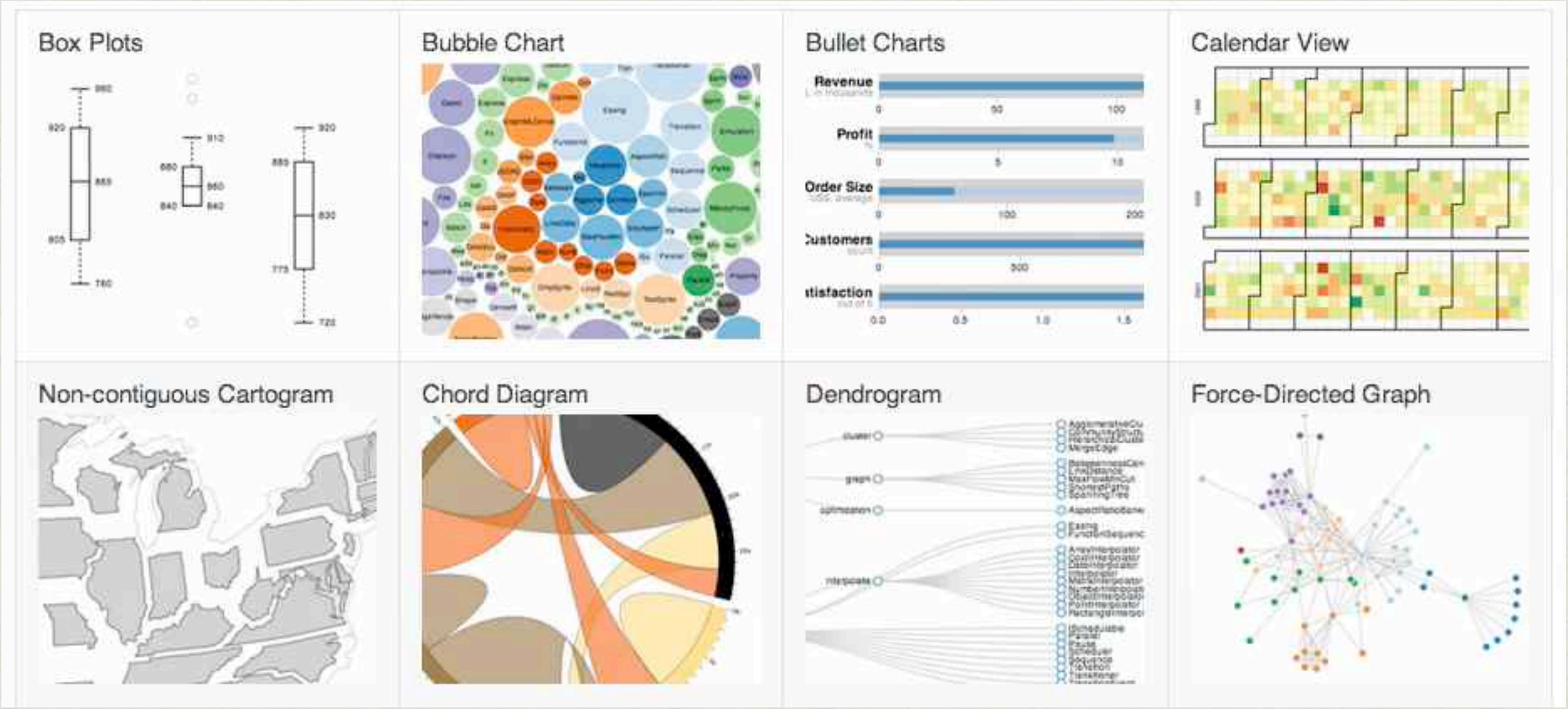
- Pros:
  - Large assortment of spatial relationship and proportion graphs
  - Comprehensive examples with source code
- Cons:
  - Development has slowed down
  - Smaller user base

JavaScript Infovis Toolkit



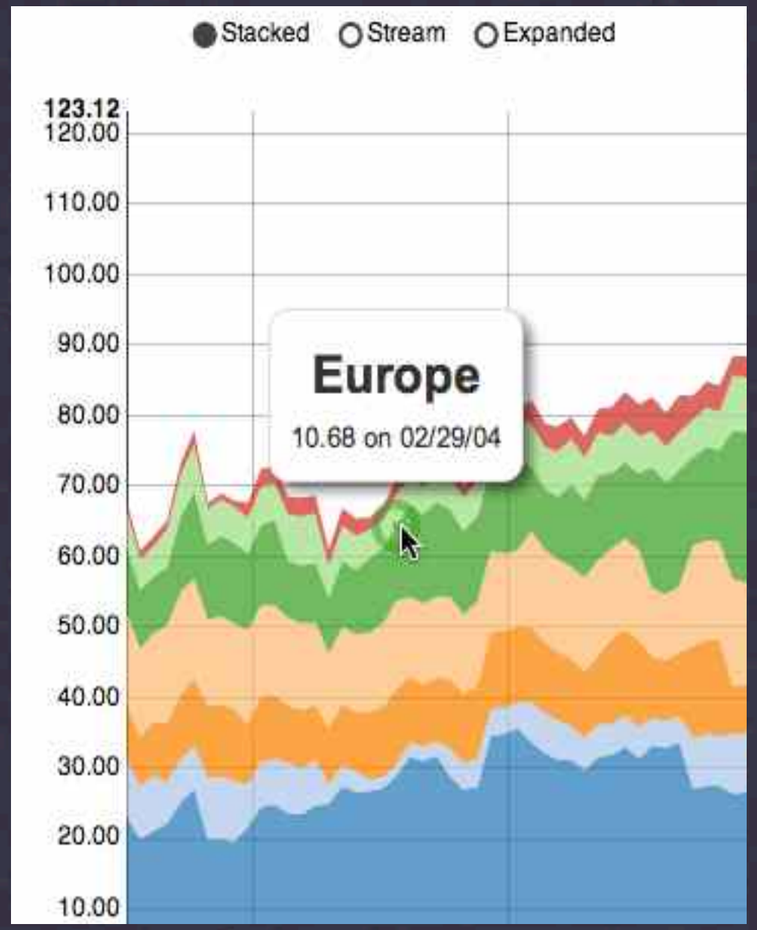


D3.js


Box Plots
Bubble Chart
Bullet Charts
Revenue
Profit
Order Size
Customers
Calendar View
Non-contiguous Cartogram
Chord Diagram
Dendrogram
Force-Directed Graph

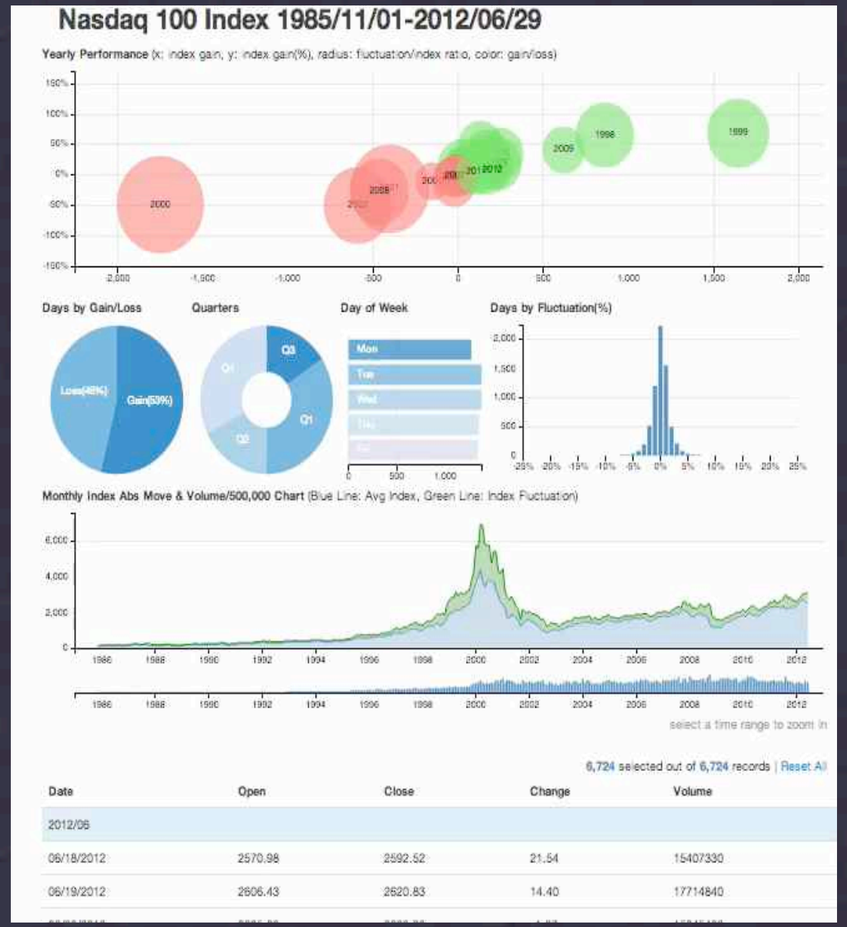
D3.js Pros + Cons

- **Pros:**
  - Powerful
  - Customizable
  - Lots of examples
  - Lots of helpers
  - Active development / User community
- **Cons:**
  - IE8 not supported
  - Low level toolkit
  - Documentation is evolving
  - Steep Learning Curve if rusty/new to JavaScript



NVD3

CUBISM



DC.JS

D3.JS HELPERS

INTEGRATING JAVASCRIPT LIBRARIES WITH APEX


<!DOCTYPE HTML
<html>
<head>
<meta
JavaScript
WINDOW
History
DOCUMENT
LINK
FORM
TEXT
RADIO
CHECKBOX
TEXTAREA
PASSWORD
SELECT
OPTIONS
BUTTON
RESET
SUBMIT
SVG
d3.js ~ Bubble Chart
mbostock.github.com/d3/ex/bubble.html

CONTEXT

DATA MOVEMENT

- **Expose server-side data to HTML page**
- **Inject HTML into your page with HTP.PRINT**

```
HTP.PRINT('<SCRIPT> ... </SCRIPT>');
```

- **Dynamic Actions**
  - Javascript call initiates call to PL/SQL function
  - PL/SQL returns results as character string
  - Plain Text/JSON/CSV/XML can be returned from Oracle to browser environment

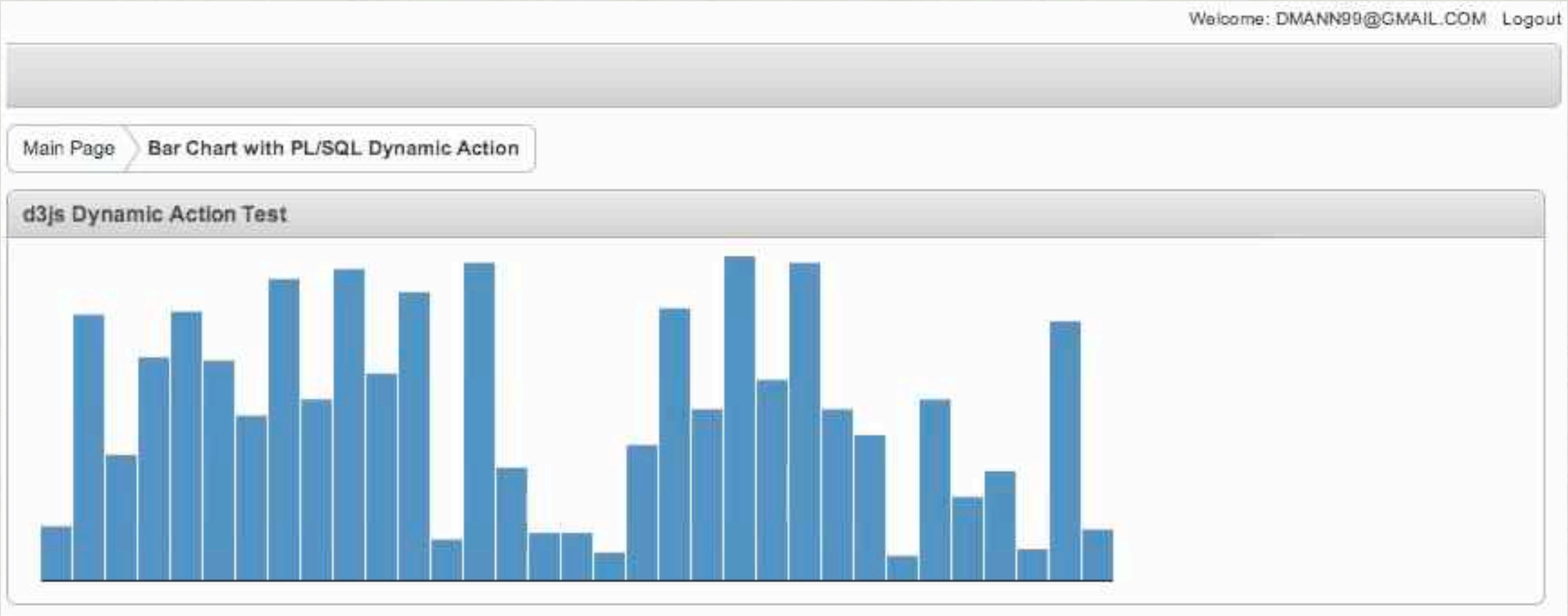
DEVELOPMENT ENVIRONMENT

- Start with HTML mock-up
- Remote development:
  - http://jsfiddle.net
- Local development:
  - Basic HTTP Server
  - Browser Developer Tools
  - Browser Javascript Console + Debugger

DEMOS

- Real Time Update
  - Smooth transition for new data points
- Visualizing Database Links
  - Node relationship

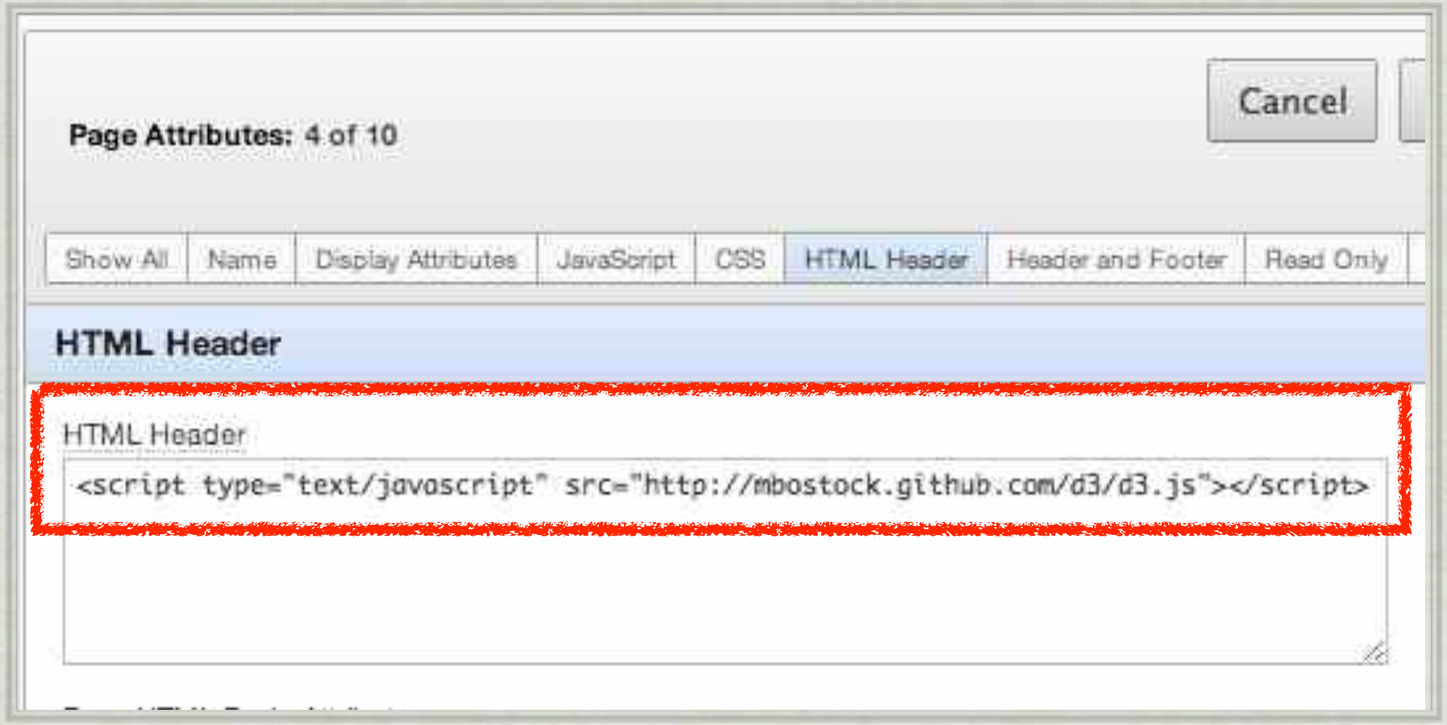
REAL TIME UPDATE WITH TRANSITION



[Link to Tutorial and Code : http://ba6.us/d3js_application_express_basic_dynamic_action](http://ba6.us/d3js_application_express_basic_dynamic_action)

JS & CSS REFERENCES FOR YOUR PAGE

- Reference in Header



- Shared Components via #WORKSPACE_IMAGES

SET UP A DYNAMIC ACTION

- Define an On Demand Process
  - Page or App Level
- Provide PL/SQL code to return a random number from 1-100 as a string
- This will be called by JavaScript on the page

Name

Page: 20 Bar Chart with PL/SQL Dynamic Action

* Name: GetRandom

Type: **PL/SQL anonymous block**

Process Point

* Sequence: 10

Process Point: On Demand - Run this process when requested by AJAX

Run Process: Once Per Page Visit (default)

Source

* Process [Download Source]

```
BEGIN
  HTP.PRINT( (1+ABS(MOD(dbms_random.random,100))) );
END;
```

WHERE THE MAGIC HAPPENS

- HTMLDB_GET asynch call to GetRandom Dynamic Action
- Character result stored in JS variable

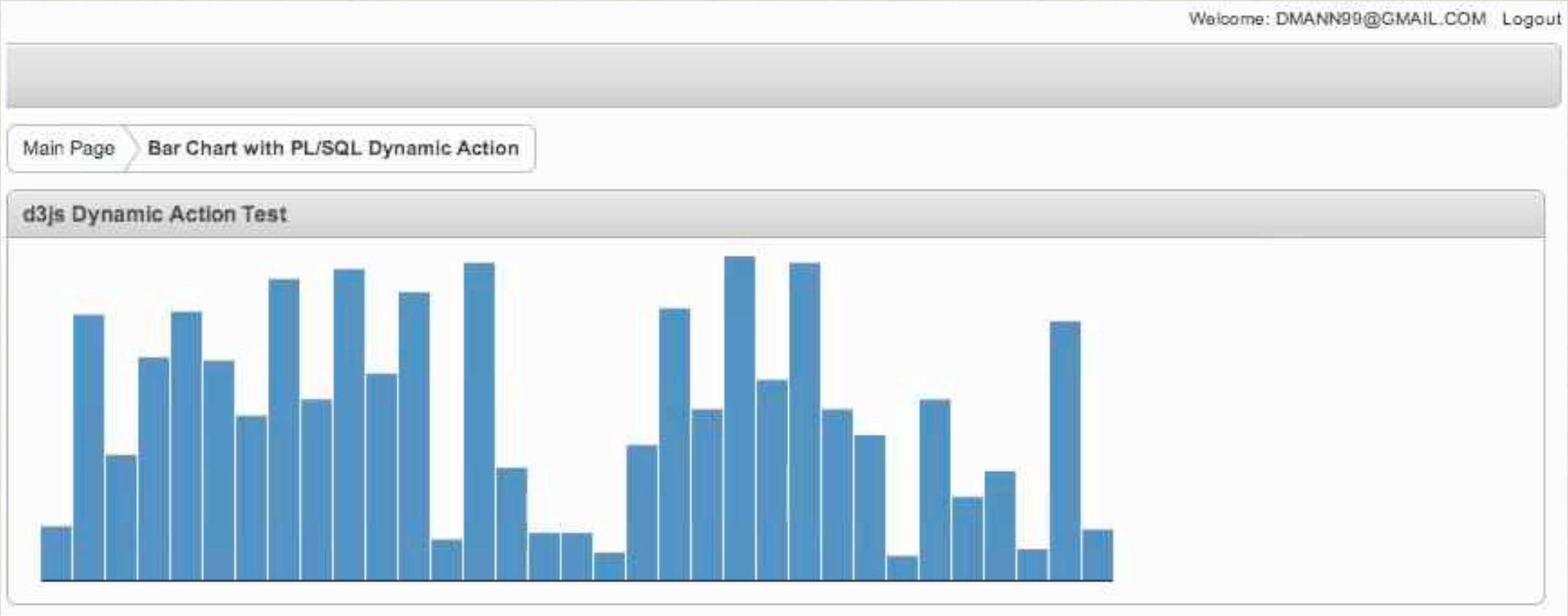
```
// Function to retrieve value from our PL/SQL Dynamic Action
function next() {

  var ajaxReq = new htmldb_Get(null, $v('pFlowId'),
                'APPLICATION_PROCESS=GetRandom', $v('pFlowStepId'));

  var gReturn = ajaxReq.get();

  // Return a JS object with a time sequence and a value
  return {
    time: ++t,
    value: gReturn
  };
}
```

IMPLEMENTATION - CODE TOUR

- Setup - DIV placeholder
- Create chart
- Draw Chart
- next() function consumes results of Dynamic Action

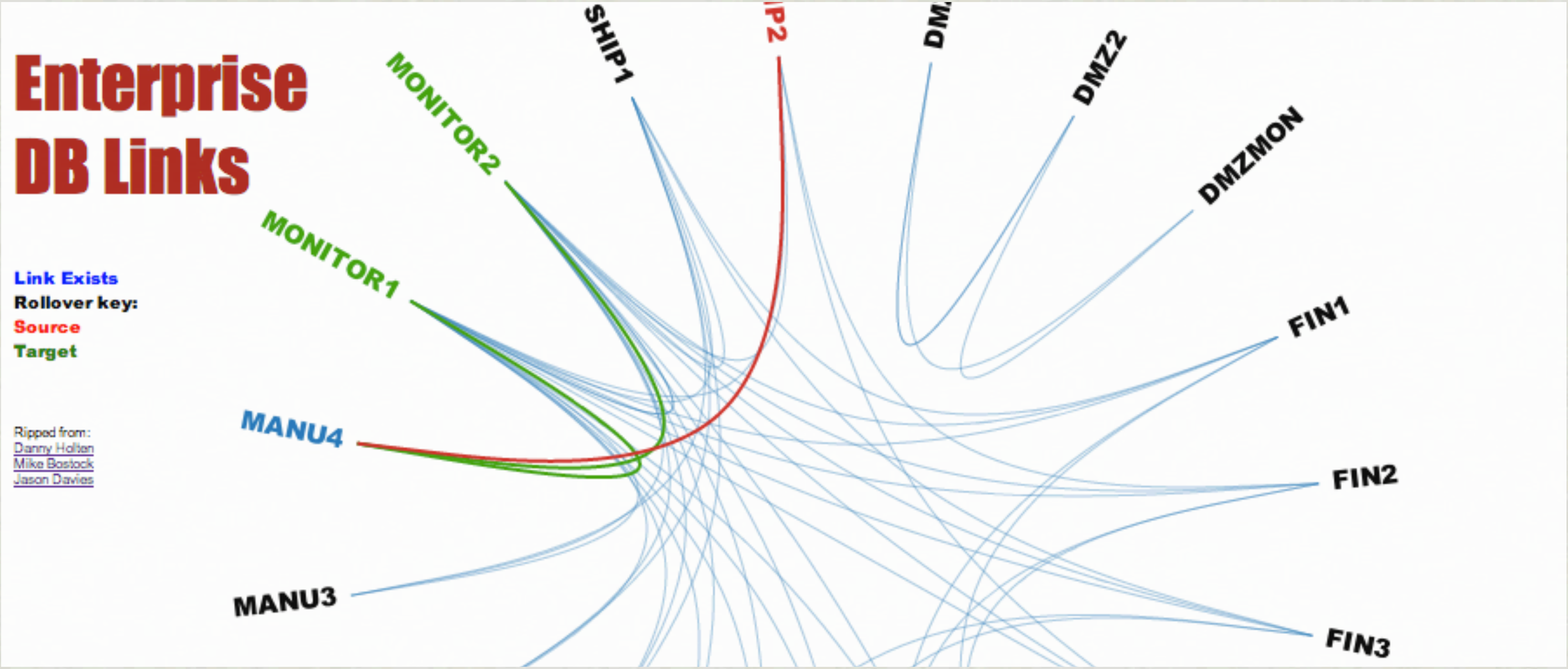
Link to Tutorial and Code : http://ba6.us/d3js_application_express_basic_dynamic_action

RESULT



[Link to Tutorial and Code : http://ba6.us/d3js_application_express_basic_dynamic_action](http://ba6.us/d3js_application_express_basic_dynamic_action)

RADIAL NODE



[Link to Mock Up : http://ba6.us/content/links1/links.html](http://ba6.us/content/links1/links.html)

IMPLEMENTATION - DYNAMIC ACTION

- Define an On Demand Process
- Provide code to return JSON as a string
- This will be called by JavaScript on the page
- JSON decoded to JavaScript object via JSON.parse()

Name

Page: **24 DB Links - Published Code**

* Name: GETLINKJSON

Type: **PL/SQL anonymous block**

Process Point

* Sequence: 10

Process Point: On Demand – Run this process when requested by AJAX

Run Process: Once Per Page Visit (default)

Source

* Process [Download Source]

```
BEGIN
  HTP.PRINT( GETLINKJSON()  );
END;
```

IMPLEMENTATION - JSON FORMAT

```
[
  {"name":"MONITOR1","linksto":["MONITOR2","HR1","HR2","HR3","HR4","FIN1",
      "FIN2","FIN3","FIN4","MANU1","MANU2", "MANU3","MANU4","SHIP1","SHIP2"]},
  {"name":"MONITOR2","linksto":["MONITOR1","HR1","HR2","HR3","HR4","FIN1",
      "FIN2","FIN3","FIN4","MANU1","MANU2","MANU3","MANU4","SHIP1","SHIP2"]},

  {"name":"HR1","linksto":["FIN1"]},
  {"name":"HR2","linksto":["FIN2"]},
  {"name":"HR3","linksto":["FIN3"]},
  {"name":"HR4","linksto":["FIN4"]},

  {"name":"FIN1","linksto":["SHIP1","HR2"]},
  {"name":"FIN2","linksto":["SHIP2","HR1"]},
  {"name":"FIN3","linksto":["SHIP1","HR4"]},
  {"name":"FIN4","linksto":["SHIP2","HR3"]},

  {"name":"MANU1","linksto":["SHIP1"]},
  {"name":"MANU2","linksto":["SHIP1"]},
...
```

```
SOURCE,TARGET
MONITOR1,MONITOR2
MONITOR1,HR1
MONITOR1,HR2
MONITOR1,HR3
MONITOR1,HR4
MONITOR1,FIN1
MONITOR1,FIN2
MONITOR1,FIN3
MONITOR1,FIN4
MONITOR1,MANU1
```

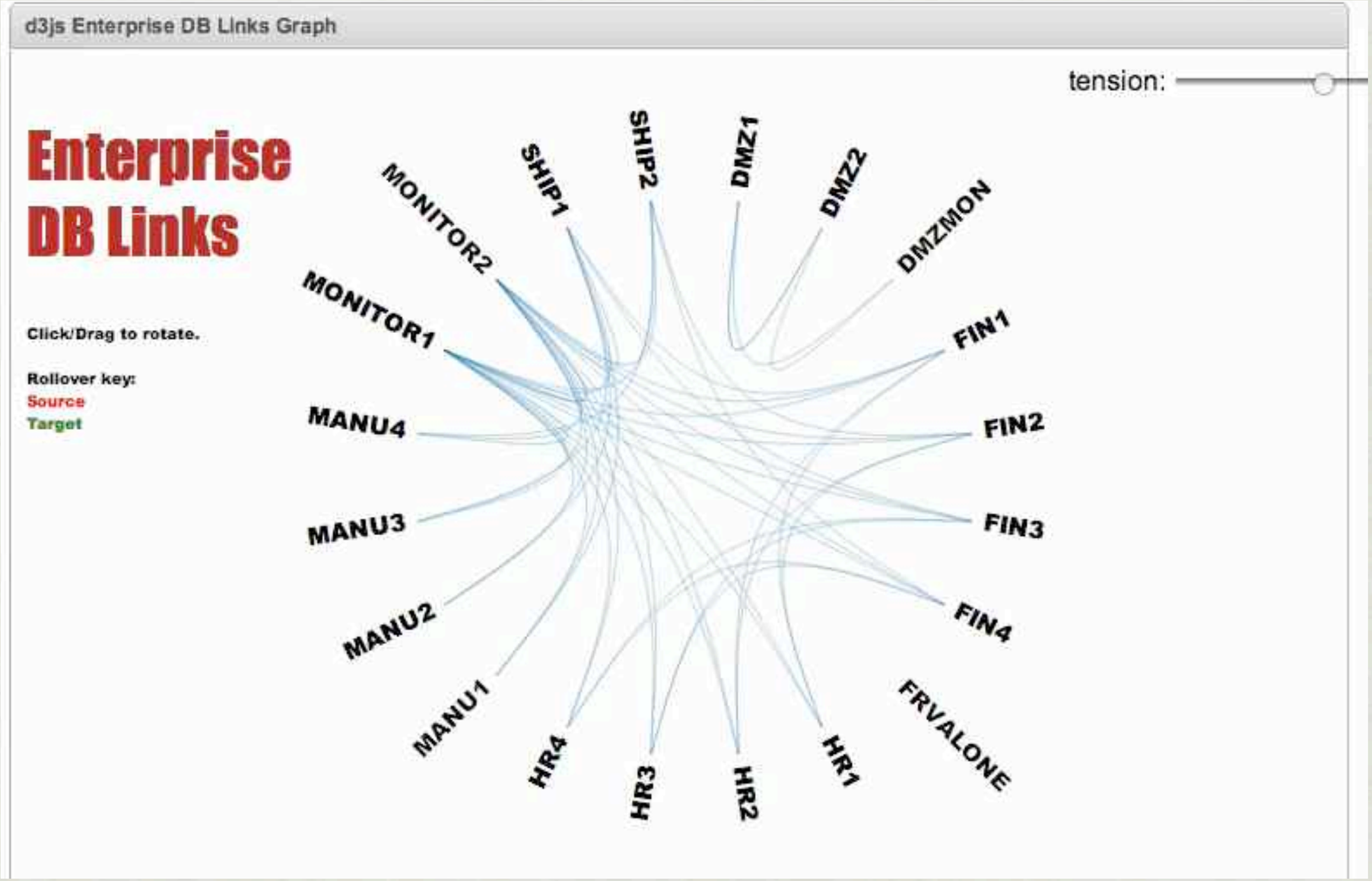
IMPLEMENTATION - PL/SQL -> JSON

```
1  create or replace FUNCTION GETLINKJSON RETURN VARCHAR2 IS
2    myOutput VARCHAR2(8192) := '['||CHR(10);
3  BEGIN
4    FOR Cur1 IN (SELECT DISTINCT SOURCE FROM DB_LINKS ORDER BY SOURCE)
5    LOOP
6      myOutput := myOutput || '{"name":"'||Cur1.SOURCE||'","imports":[';
7      FOR Cur2 IN (SELECT DISTINCT TARGET FROM DB_LINKS
8                   WHERE SOURCE=Cur1.SOURCE ORDER BY TARGET)
9      LOOP
10       myOutput := myOutPut || '"' || Cur2.TARGET || '",';
11     END LOOP;
12     myOutput := SUBSTR( myOutput, 1, LENGTH(myOutput)-1 );
13     myOutput := myOutput || ']},' || CHR(10);
14   END LOOP;
15     myOutput := SUBSTR( myOutput, 1, LENGTH(myOutput)-2 );
16   myOutput := myOutput || ']';
17   --DBMS_OUTPUT.PUT_LINE(myOutput);
18   RETURN myOutput;
19 END;
```

IMPLEMENTATION - CODE TOUR

- Tension slider and Static Text
- JS Includes
- JS Script
  - Setup
  - add a DIV, then add SVG canvas
  - Get and parse data
  - Render
  - Dynamic behavior + transition response to behavior
- Based On : http://bl.ocks.org/mbostock/1044242

RESULT



Example

Mock Up

Where do we go from here?

- Browse tool offerings, check their examples & kick tires
- Mock up an HTML/JS page with sample data
- Work out method to generate live data
- “Apexify” your page, test, and deploy
- Don’t be afraid to fail. Iterate and Refine!
- Interactivity - leverage animation and transformations to explore your data

QUESTIONS

Slides, code, links :
http://ba6.us

Email: david@ba6.us
Twitter: @ba6dotus

Project Sites

- https://developers.google.com/chart/
- http://thejit.org
  - Nicolas Belmonte
- http://d3js.org
  - http://AlignedLeft.com
  - http://JasonDavies.com
  - http://www.d3noob.org

Viz Blogs

- http://FlowingData.com
- http://EagerEyes.org
- http://visual.ly
- http://Visualizing.org

References

- http://groups.google.com/group/d3-js
- http://www.janwillemtulp.com/2011/04/01/tutorial-line-chart-in-d3/
- http://www.slideshare.net/RRomme/advanced-reporting-and-charting-with-oracle-application-express-40
- http://svgmagazine.com/jul2011/spotson_d3.js.html
- http://techslides.com/over-1000-d3-js-examples-and-demos/
- Viz of d3 related books: http://www.yasiv.com/amazon#/Search?q=d3&category=Books&lang=US
- MultiVariate Display Considerations