

Visualizing Hierarchy

INTRODUCTION

Hierarchical Data

- Any data with some sort of hierarchy
- Example hierarchy
 - Country: United States
 - Region: West
 - State: California
 - County: San Francisco County
 - City: San Francisco

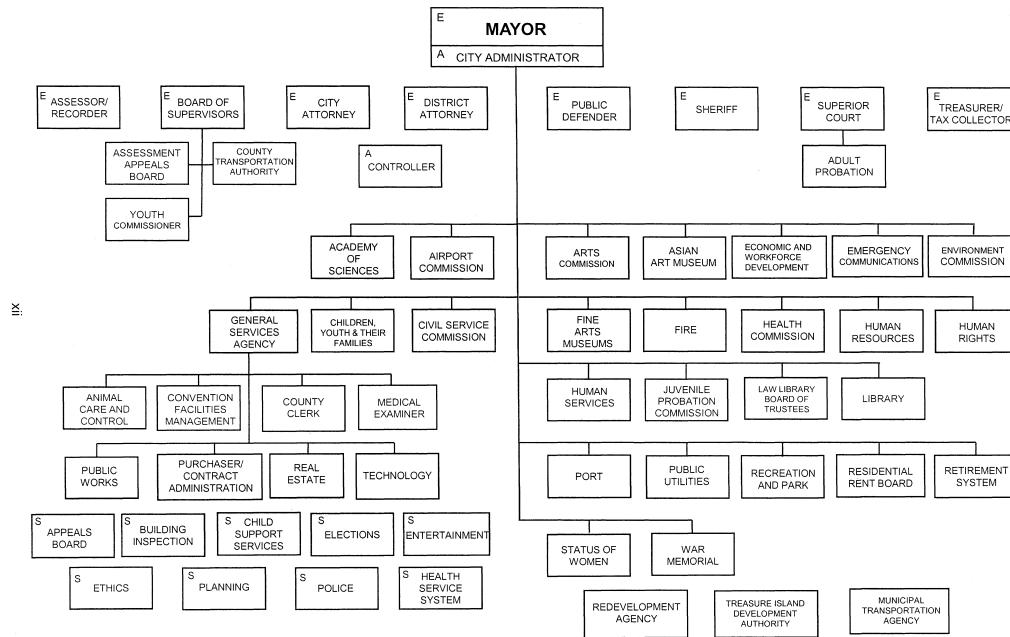
<http://en.wiktionary.org/wiki/hierarchy>

Example Hierarchies

- Evolutionary Tree
- Dendograms
- File Directory Structure
- Dewey Decimal System
- Family Tree
- Outlines
- Organization Charts
 - Businesses
 - Churches
 - Military
 - Government

City and County of San Francisco Organization Chart

(As of June 30, 2010)



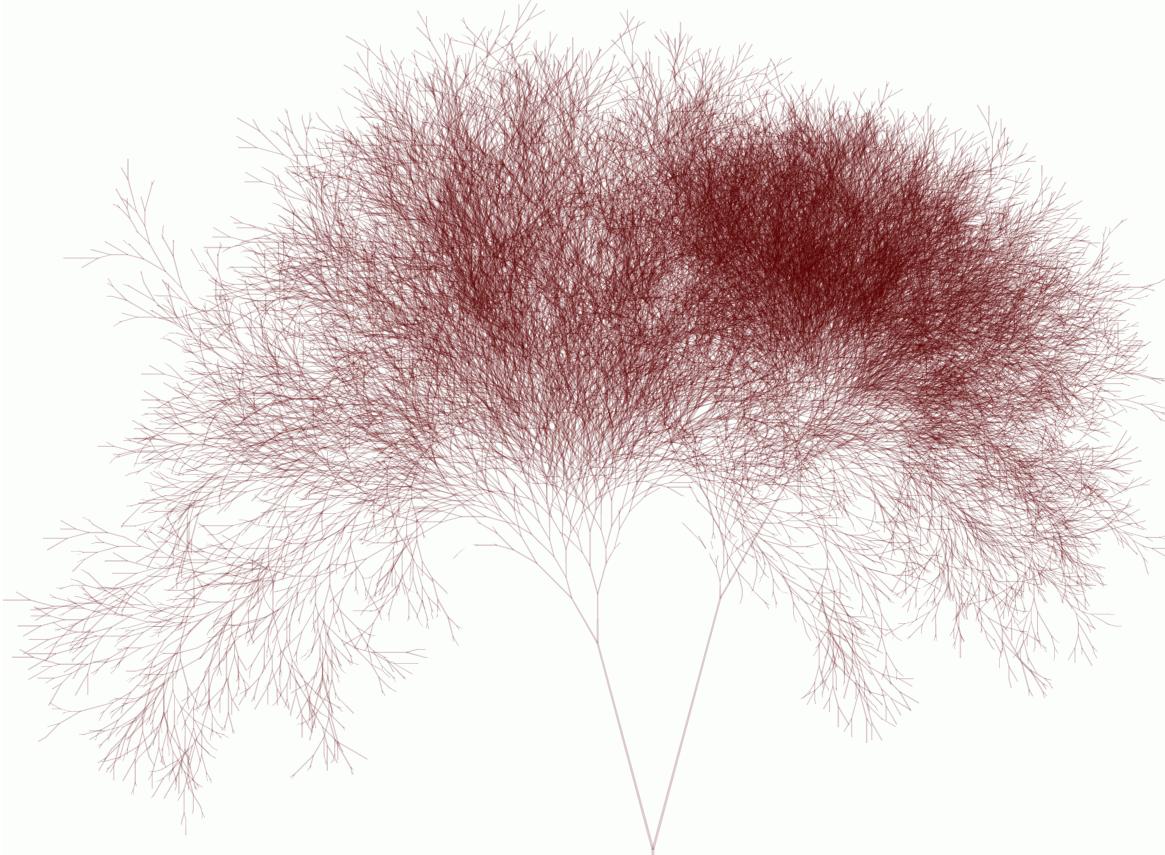
A = Appointed by Mayor and confirmed by Board of Supervisors / E = Elected / S = Shared – appointed by various elected officials.

<http://sfgov.org/citys-organizational-chart>

Trees

- Tree structure
- Tree (graph theory)
- Tree (set theory)
- Tree (data structure)

[https://en.wikipedia.org/wiki/Tree_\(disambiguation\)](https://en.wikipedia.org/wiki/Tree_(disambiguation))



<http://drunkmenworkhere.org/219>

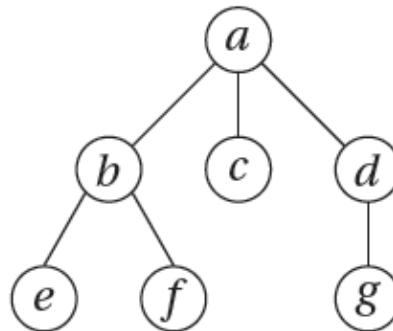
Trees

- Used to model hierarchical data
- Special type of graph
 - Must be **acyclic**, i.e. has no cycles or loops
 - Must be **undirected**, i.e. arrow-less edges
 - Usually **rooted** (a single node at top)
 - Each **subgraph** is also a tree (**subtree**)

<http://xlinux.nist.gov/dads/HTML/tree.html>

Tree Terminology

FIGURE 2.8: TREE TERMINOLOGY AND NOTATION



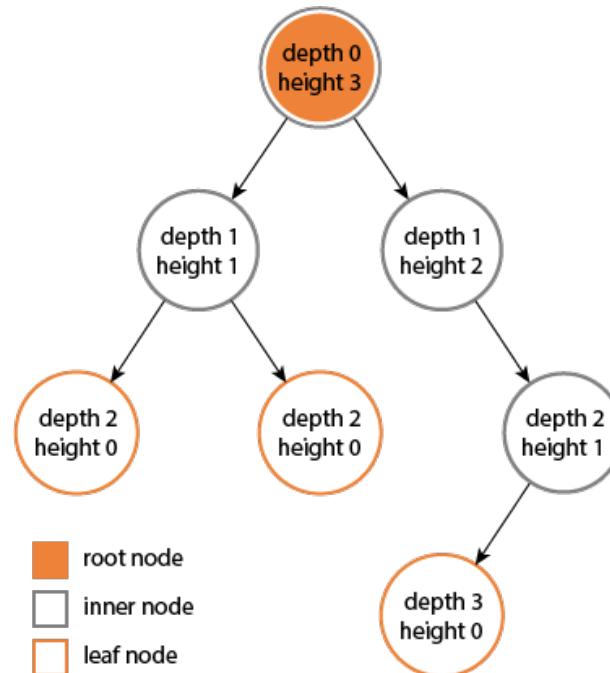
$G = (N, E)$ where

$$N = \{ a, b, c, d, e, f, g \}$$

$$E = \{ (a, b), (a, c), (a, d), (b, e), (b, f), (d, g) \}$$

Example tree $G = (N, E)$. Some observations: Each node has a unique label. Node a is the root node. Nodes a , b , and d are internal nodes. Nodes c , e , f , and g are leaf nodes. Node d is a parent node to node g , and node g is a child node to d . Nodes e and f share the same parent node b and are considered siblings.

Tree Terminology



<http://stackoverflow.com/questions/2603692/what-is-the-difference-between-tree-depth-and-height>

https://en.wikipedia.org/wiki/Tree_%28data_structure%29

Tree Visualization

- Node-Link Diagrams
 - Traditional node-link diagram
 - Dendograms
 - Hyperbolic trees
- Space-Filling Diagrams
 - Treemaps
 - Sunbursts

How to cite this site?

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treevis.net - A Visual Bibliography of Tree Visualization 2.0 by Hans-Jörg Schulz



12

v.14-MAR-2016

Dimensionality



Representation



Alignment



Fulltext Search

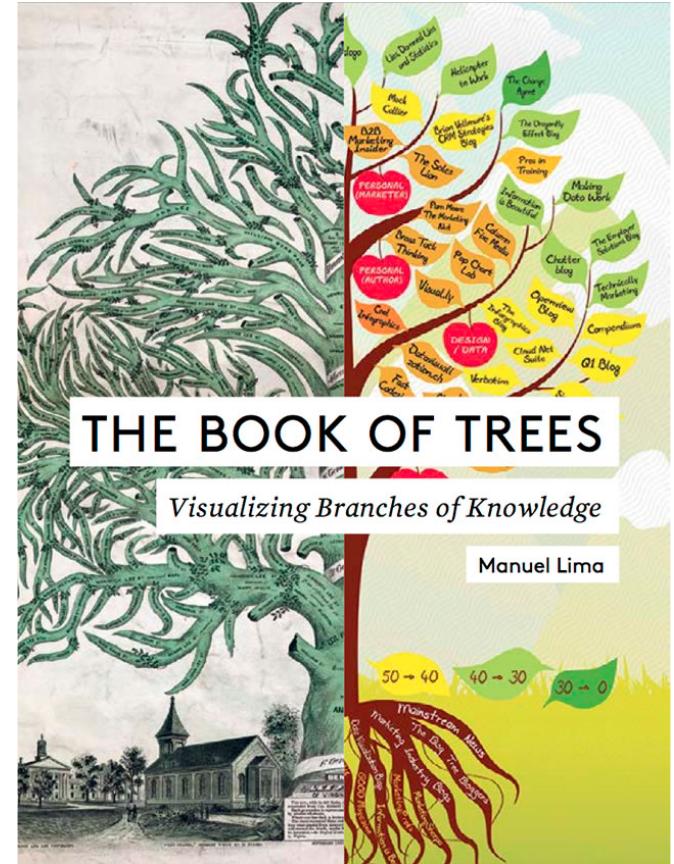
 x

Techniques Shown

292



<http://vcg.informatik.uni-rostock.de/~hs162/treeposter/poster.html>



<http://www.bookoftrees.info/bt/>



Considerations

- What is the root node? What is the parent/child of node x ? Can you find the path between node x and node y ?
- What is the height of the tree/subtree? What is the level of a specific node? How many nodes are on level x ?
- Are the labels readable? All nodes visible? Are node attributes visible? Are link attributes visible?
- Can both nodes and links be interacted with? What type of interaction is supported?
- How much space is required to visualize the tree? Are the nodes or the hierarchy given more space?

NODE-LINK DIAGRAMS

Indented Layout

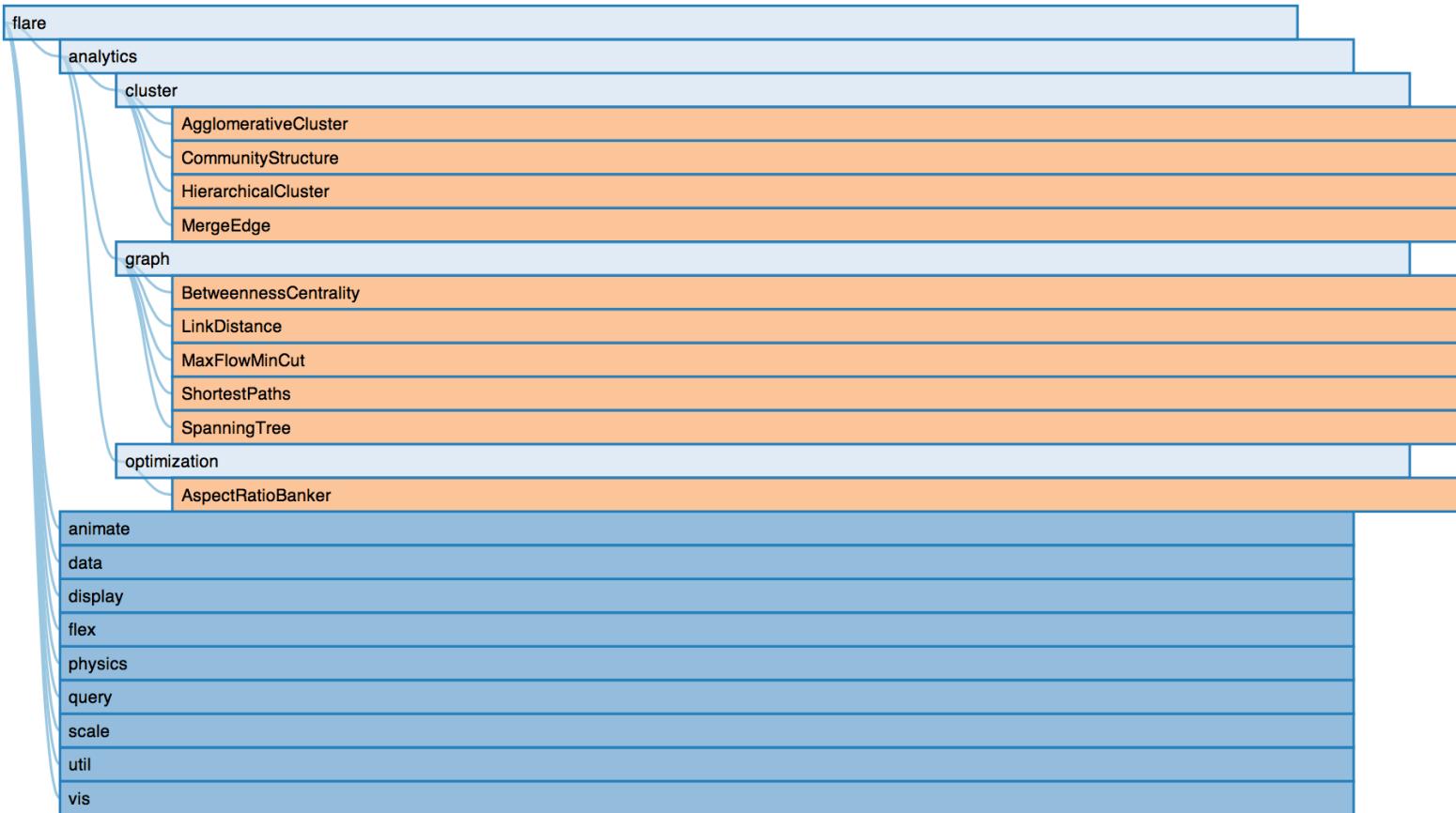
- Child nodes placed below parent and indented
- Compact width
- Height expands and shrinks
- Often used to navigate file systems
- Difficult to see all nodes of a specific level

flare	933KB
analytics	47KB
cluster	14KB
AgglomerativeCluster	3KB
CommunityStructure	3KB
HierarchicalCluster	6KB
MergeEdge	0KB
graph	25KB
BetweennessCentrality	3KB
LinkDistance	5KB
MaxFlowMinCut	7KB
ShortestPaths	5KB
SpanningTree	3KB
optimization	6KB
AspectRatioBanker	6KB
animate	97KB
Easing	16KB
FunctionSequence	5KB
ISchedulable	1KB
Parallel	5KB
Pause	0KB
Scheduler	5KB
Sequence	5KB
Transition	8KB
TransitionEvent	1KB
Transitioner	19KB
Tween	5KB
interpolate	22KB
ArrayInterpolator	1KB
ColorInterpolator	1KB
DateInterpolator	1KB
Interpolator	8KB
MatrixInterpolator	2KB
NumberInterpolator	1KB
ObjectInterpolator	1KB
PointInterpolator	1KB
RectangleInterpolator	1KB

<http://mbostock.github.io/protovis/ex/indent.html>

►	📁 Archived Resources
►	📁 CS 107 App Inventor
►	📁 CS 110 Intro to CS I
►	📁 CS 112 Intro to CS II
▼	📁 CS 212 Software Development
►	📁 2012 Fall
►	📁 2012 Spring
►	📁 2013 Spring
▼	📁 Lectures
 00 Eclipse Setup.pdf	
 00 Eclipse SVN Setup.pdf	
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 02 Data Structures.pdf	
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 05 Inheritance, Part 1.pdf	
 05 Inheritance, Part 2.pdf	
 06 Exceptions.pdf	
 07 Logging.pdf	
 08 Advanced Multithreading.pdf	
 08 Multithreading Basics.pdf	
 09 Web, HTTP, and HTML.pdf	
 10 Dynamic Webpages.pdf	
 11 Relational Databases.pdf	
►	📁 CS 326 Operating Systems
►	📁 CS 360 Data Visualization
►	📁 MSAN 501 Computational Intensive
►	📁 MSAN 622 Information Visualization

Mac Finder

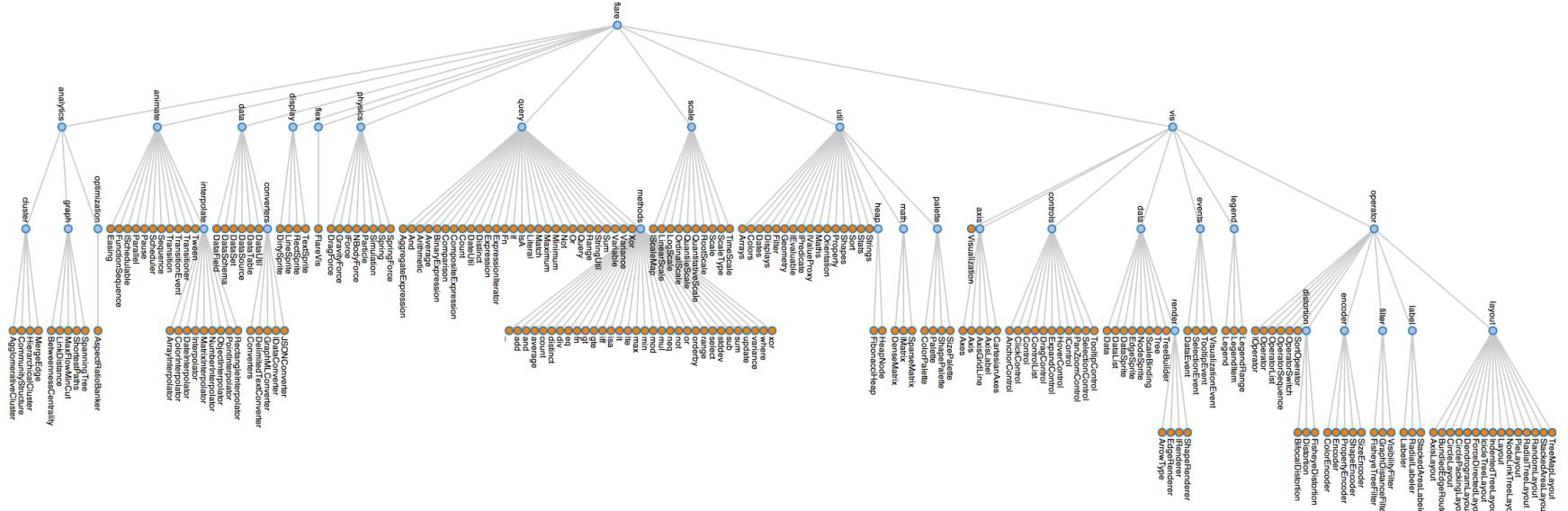


<http://bl.ocks.org/mbostock/1093025>

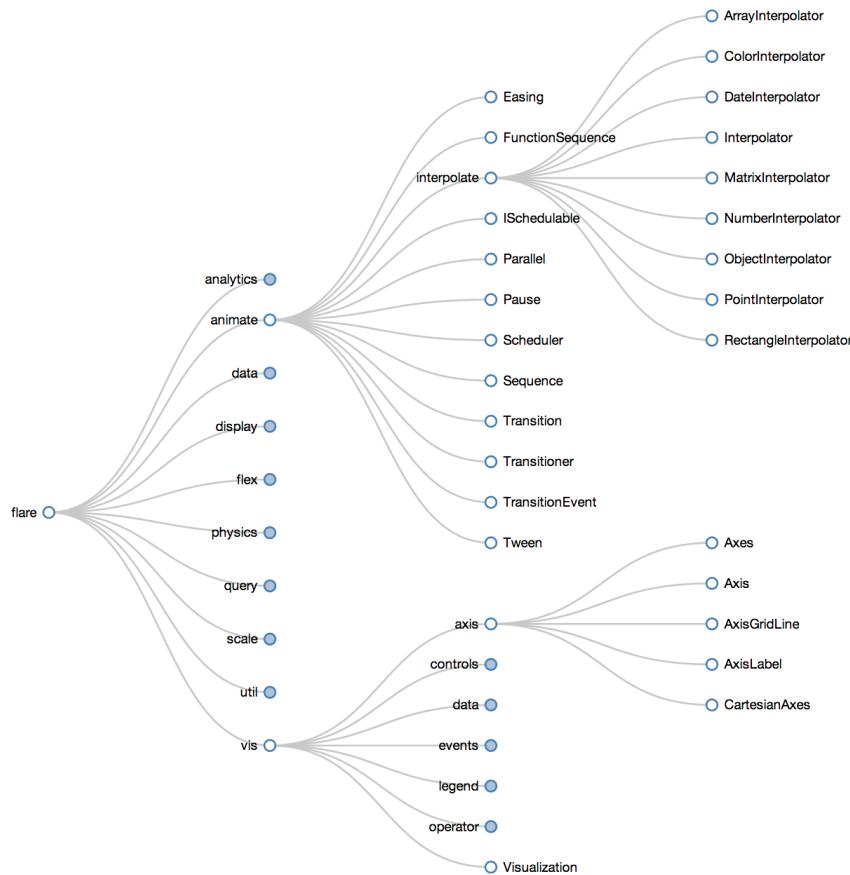
Node-Link Diagrams

- Traditional Layout
 - Nodes laid out by level, root at top
 - Edges connect adjacent nodes
- Dendrogram
 - All leaves at bottom of diagram
 - Edges usually drawn with sharp corners
 - Often used to show clusters (cluster layout)

Traditional Layout

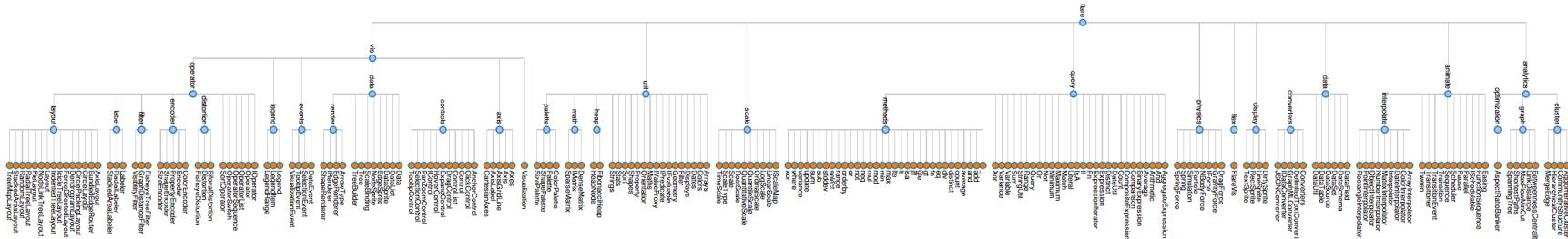


<http://hci.stanford.edu/jheer/files/zoo/ex/hierarchies/tree.html>



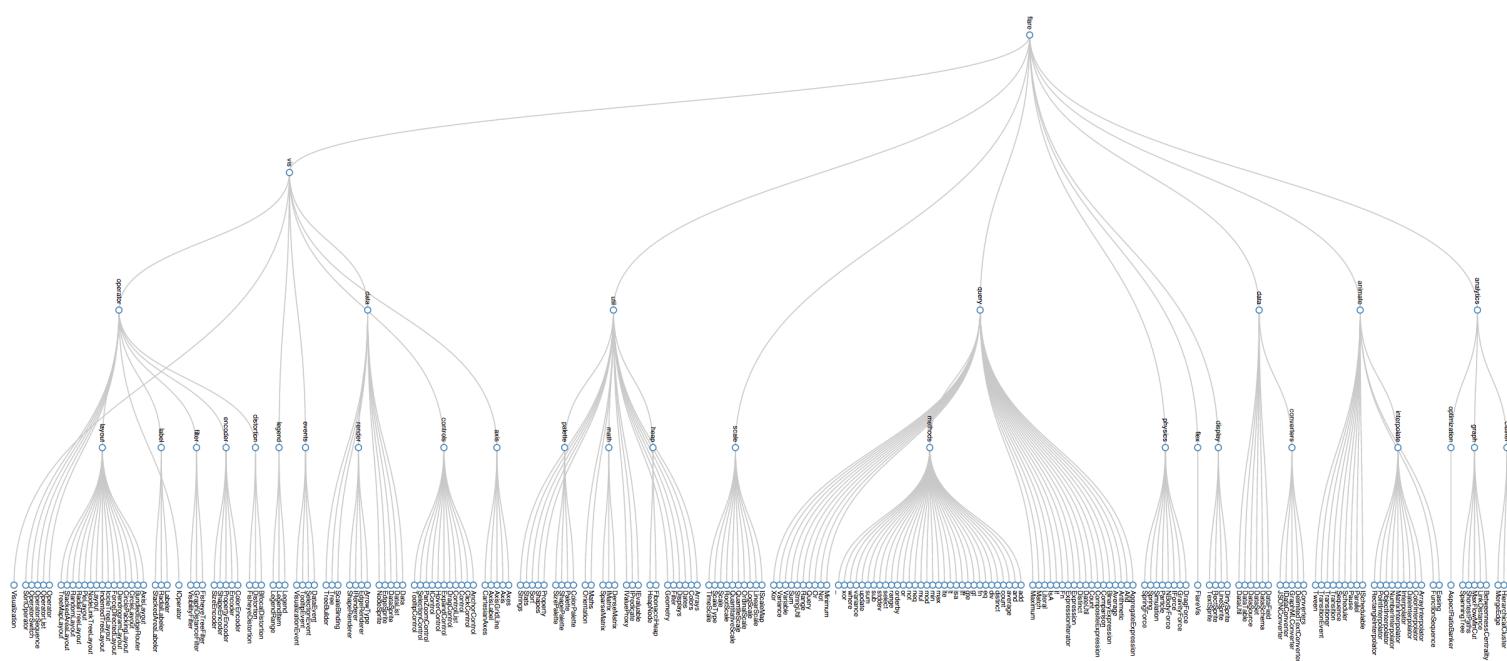
<http://mbostock.github.io/d3/talk/20111018/tree.html>

Dendrogram



<http://mbostock.github.io/protovis/ex/dendrogram.html>

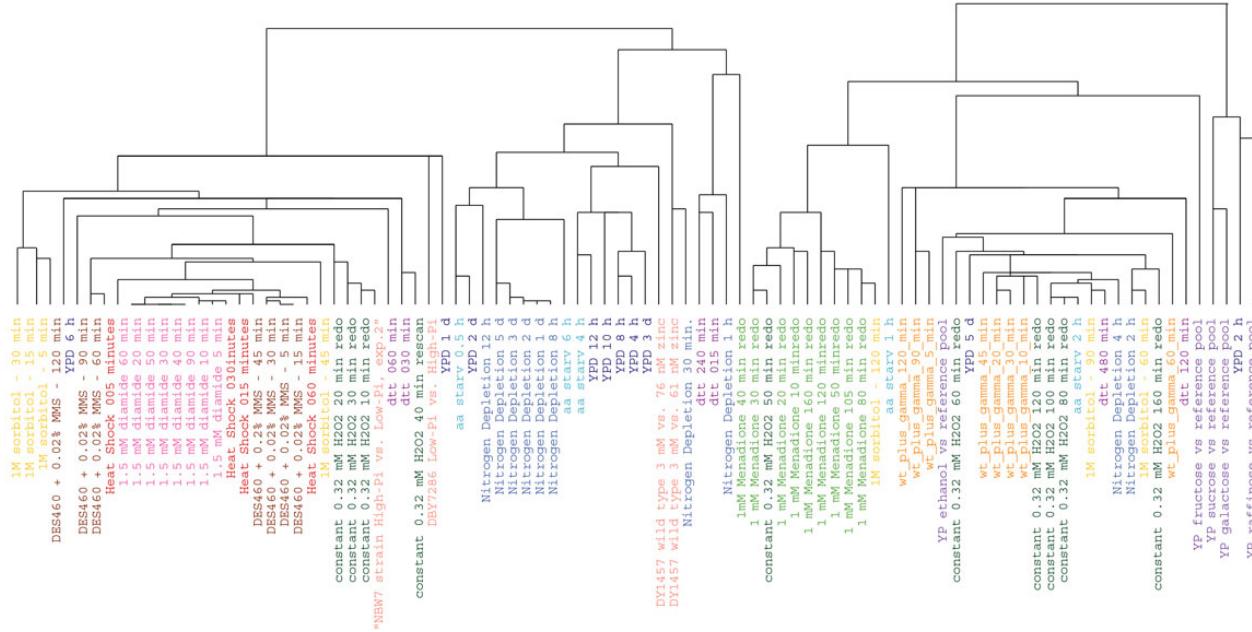
Dendrogram



<http://mbostock.github.io/protovis/ex/dendrogram.html>

Dendrogram

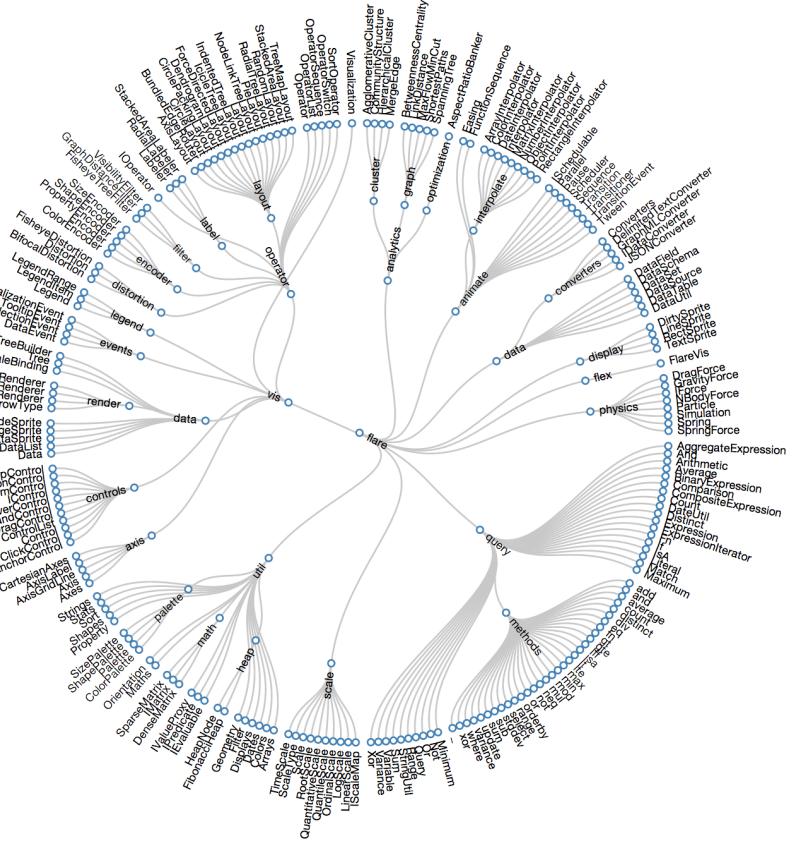
Cluster 11: protein folding chaperones



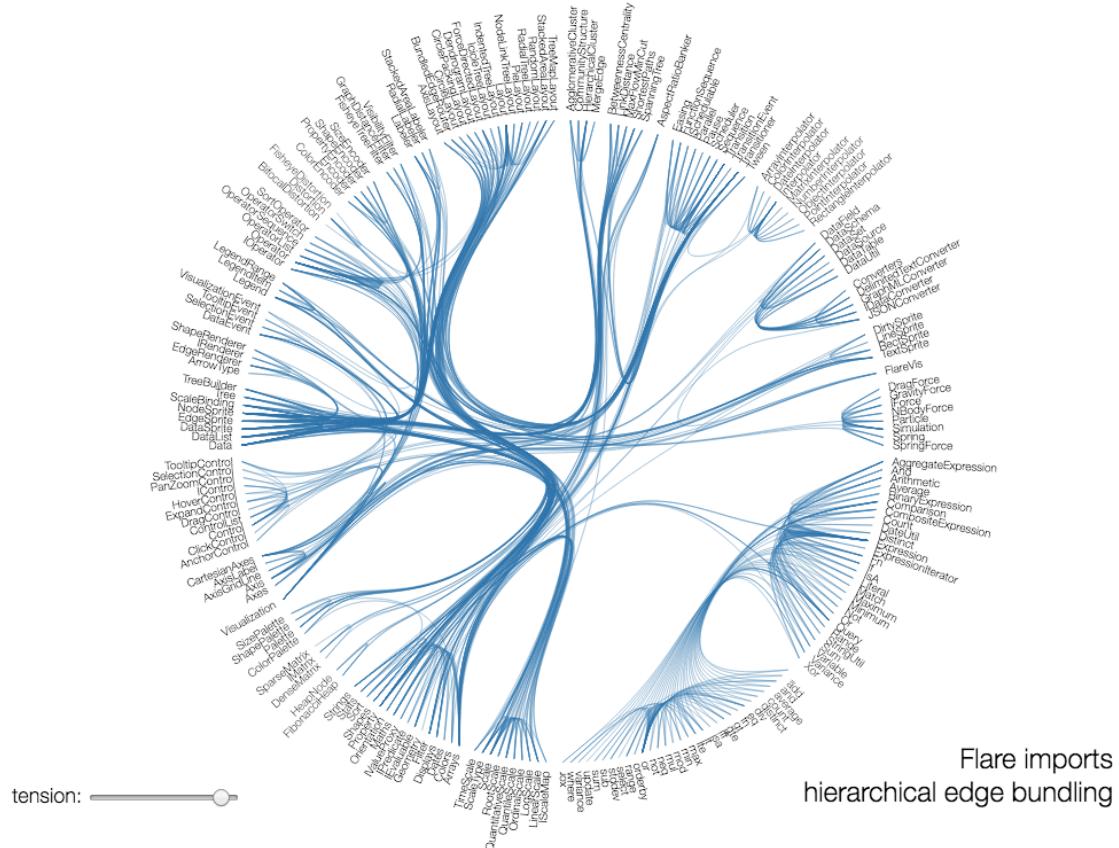
http://www.eisenlab.org/FuzzyK/images/Cluster11_atr.jpg



<http://bl.ocks.org/mbostock/4063550>

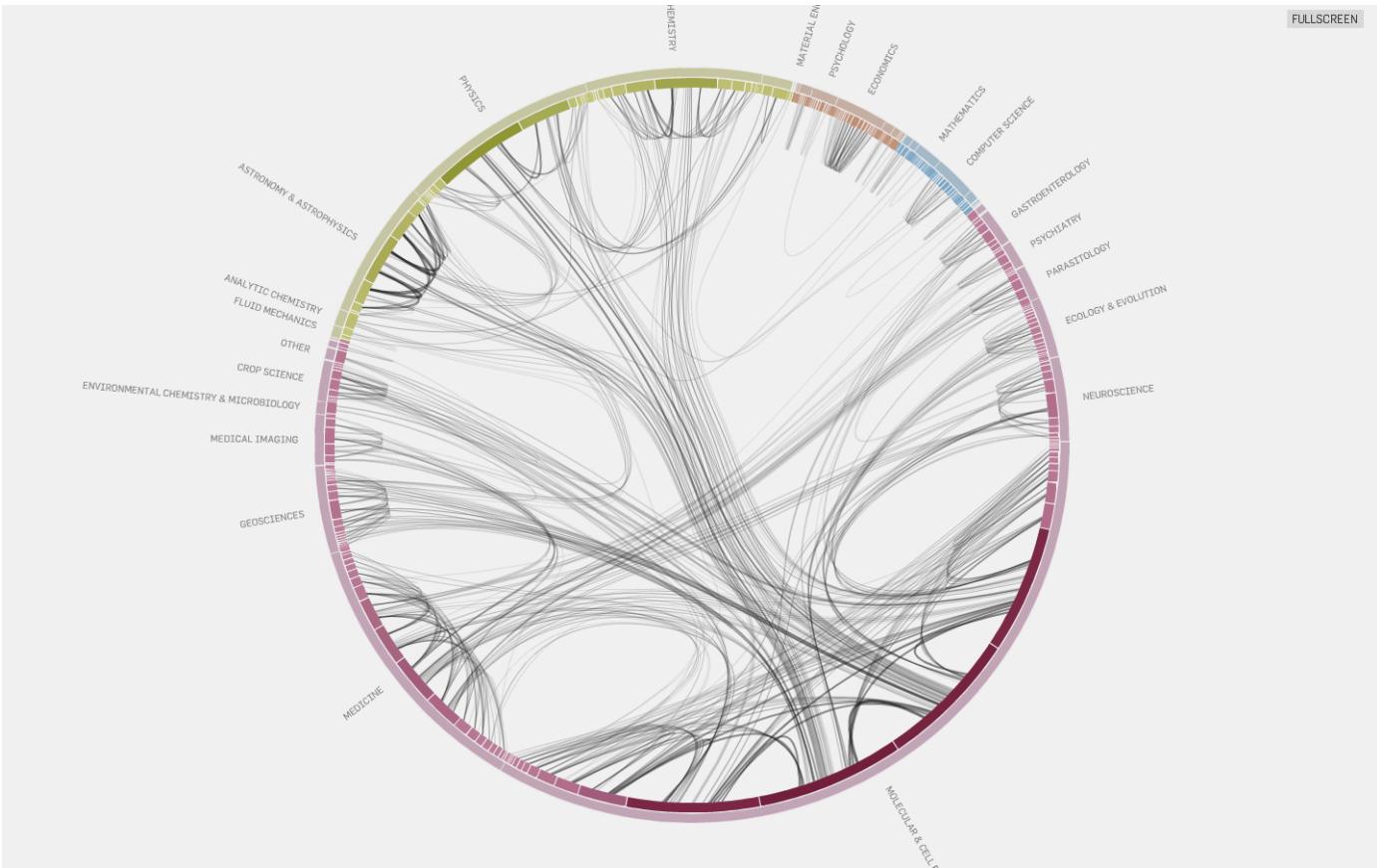


<http://mbostock.github.io/d3/talk/20111018/cluster.html>

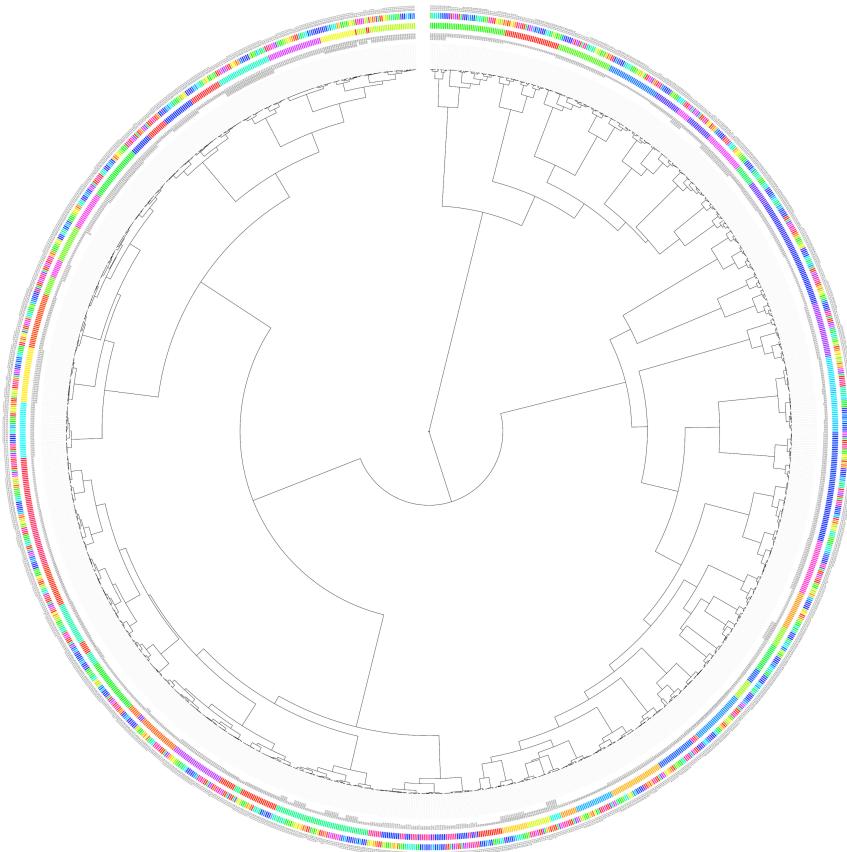


<http://mbostock.github.io/d3/talk/20111116/bundle.html>

FULLSCREEN

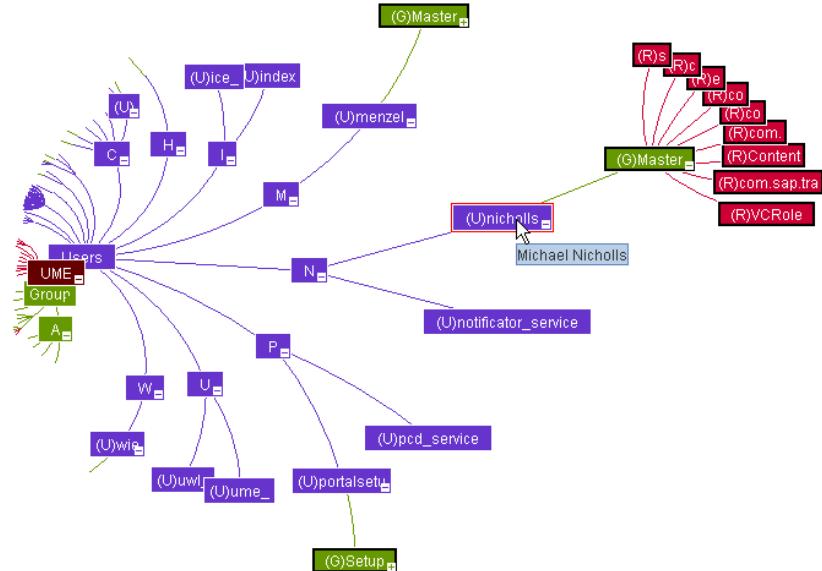


<http://www.eigenfactor.org/projects/well-formed/radial.html>

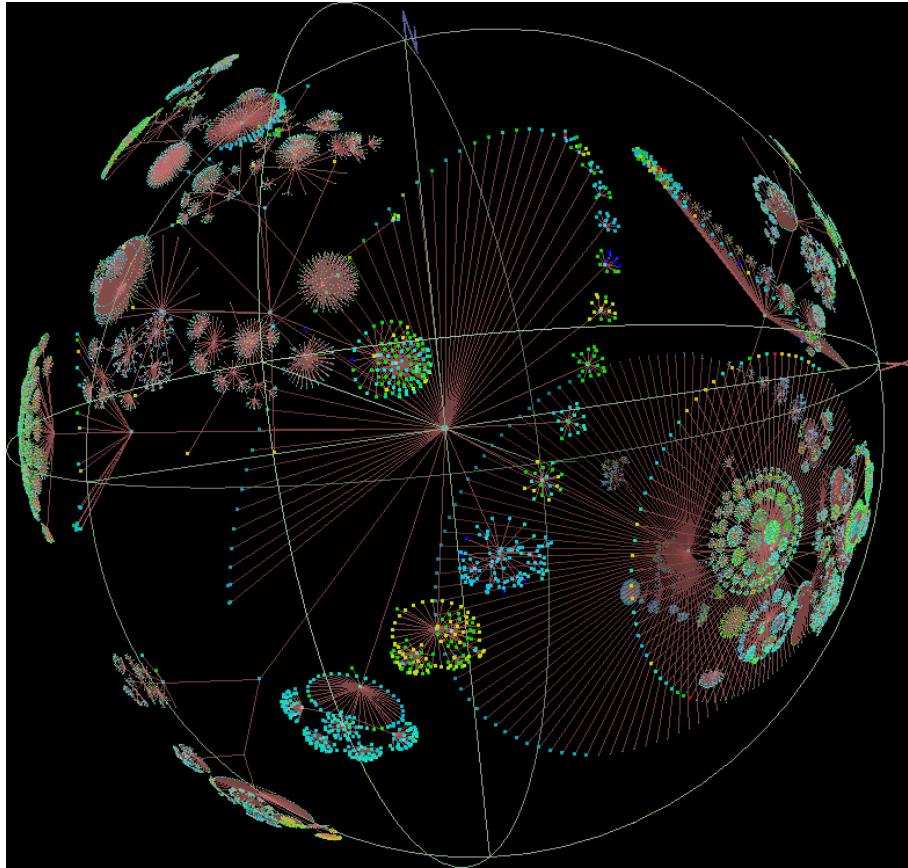


<http://cs.jhu.edu/~razvanm/fs-expedition/2.6.x.html>

Hyperbolic Tree



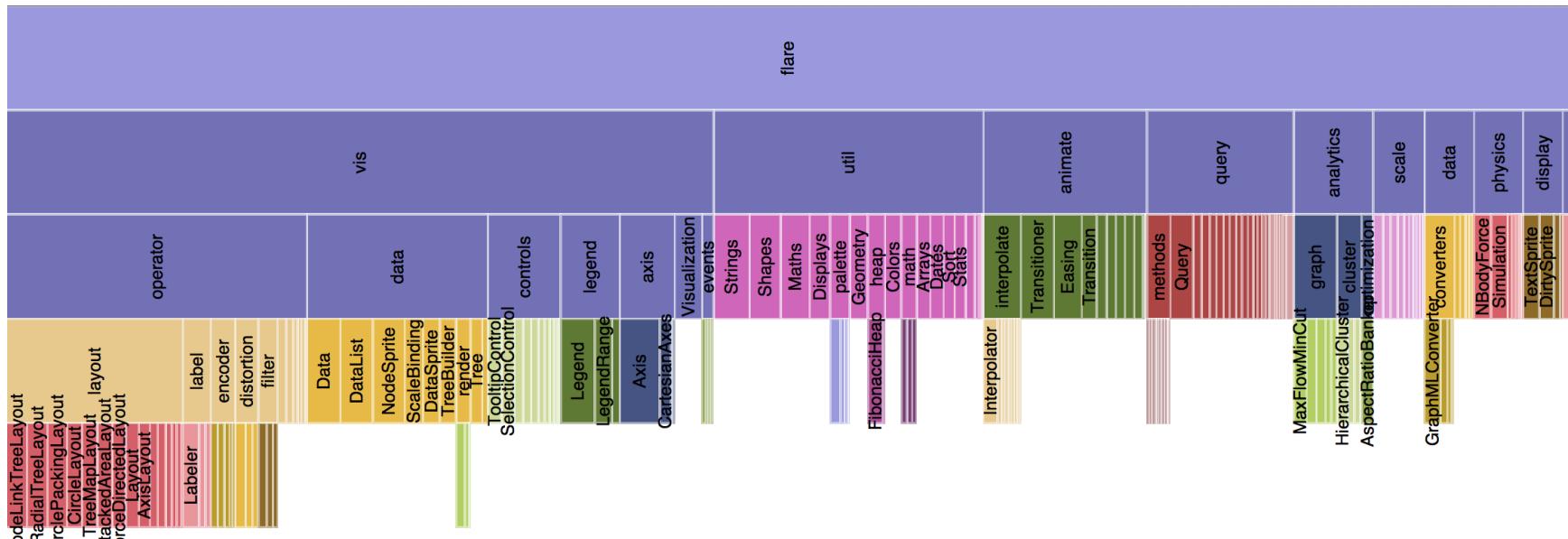
<http://wiki.sdn.sap.com/wiki/display/EmTech/StarTree+examples>



<http://www.caida.org/tools/visualization/walrus/>

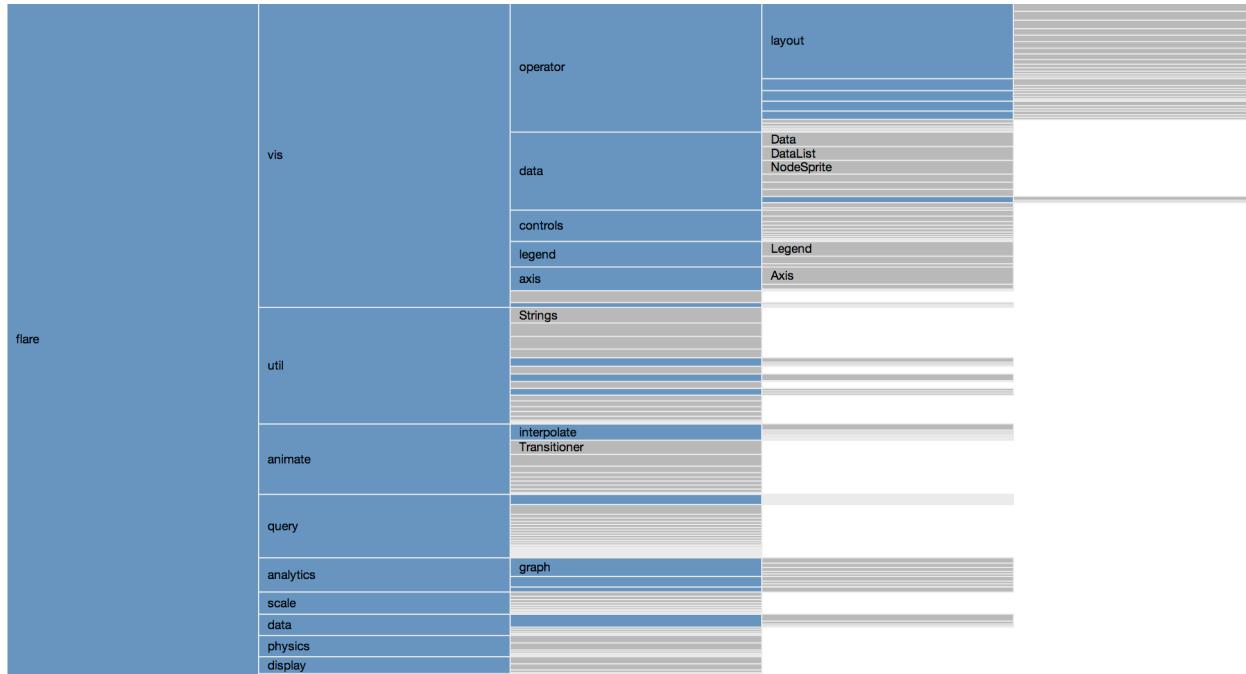
SPACE-FILLING DIAGRAMS

Icicle Diagram



<http://mbostock.github.io/protovis/ex/icicle.html>

Icicle Diagram



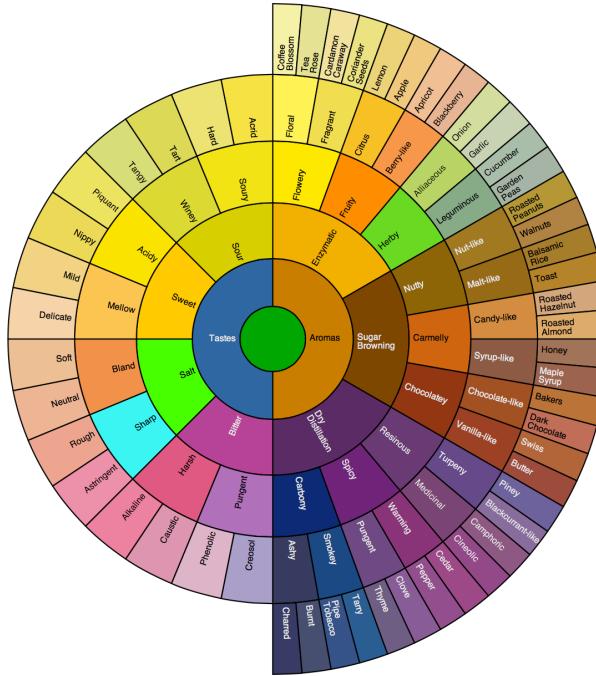
<http://mbostock.github.io/d3/talk/20111018/partition.html>

Sunburst Diagram



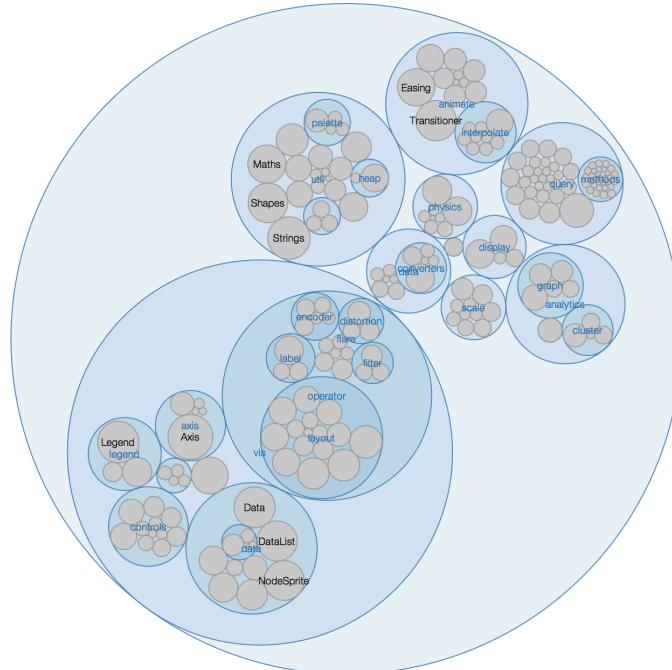
<http://bl.ocks.org/mbostock/4063423>

Sunburst Diagram



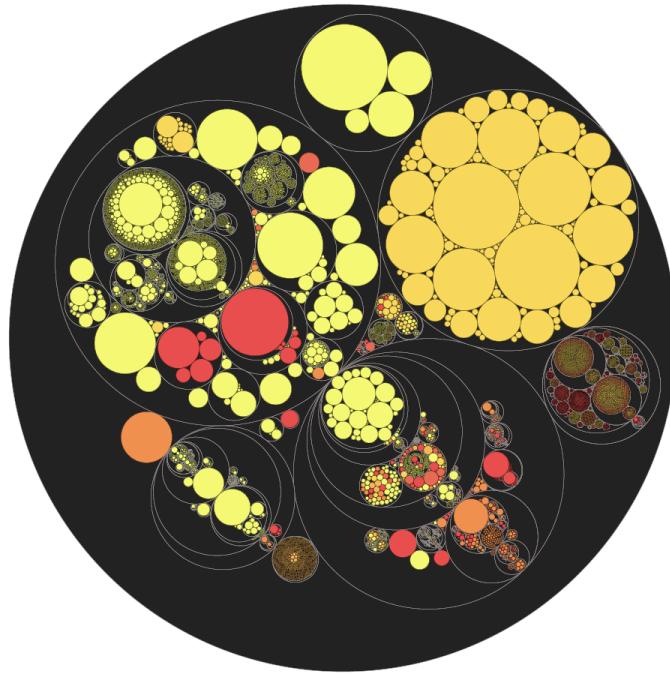
<http://www.jasondavies.com/coffee-wheel/>

Circle Packing

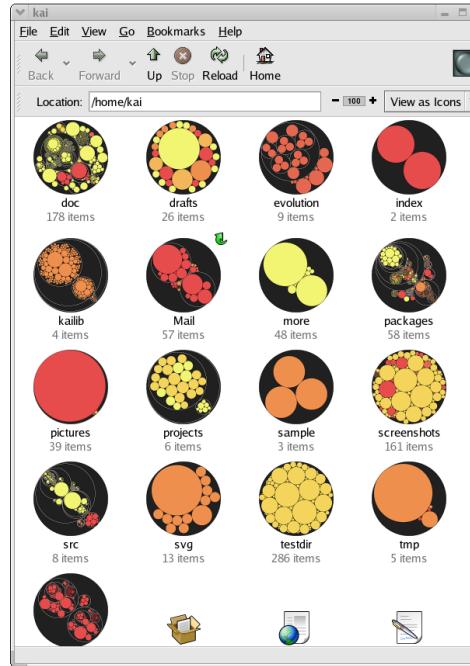


<http://mbostock.github.io/d3/talk/20111116/pack-hierarchy.html>

Pebbles File Manager



<http://lip.sourceforge.net/ctreemap.html>



PRTG Network Monitor



https://prtg.paessler.com/help/general_layout.htm



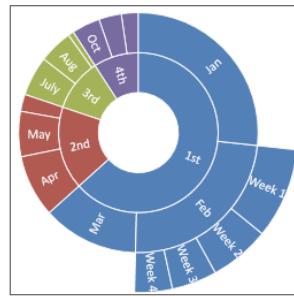
Mainstream* Adoption?

Create a sunburst chart in Office 2016

APPLIES TO: Excel 2016, Word 2016, Outlook 2016, PowerPoint 2016

Which version do I have?

The sunburst chart is ideal for displaying hierarchical data. Each level of the hierarchy is represented by one ring or circle with the innermost circle as the top of the hierarchy. A sunburst chart without any hierarchical data (one level of categories), looks similar to a donut chart. However, a sunburst chart with multiple levels of categories shows how the outer rings relate to the inner rings. The sunburst chart is most effective at showing how one ring is broken into its contributing pieces, while another type of hierarchical chart, the treemap chart, is ideal for comparing relative sizes.



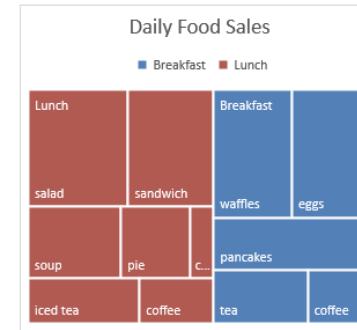
Create a treemap chart in Office 2016

APPLIES TO: Excel 2016, Word 2016, Outlook 2016, PowerPoint 2016

Which version do I have?

A treemap chart provides a hierarchical view of your data and makes it easy to spot patterns, such as which items are a store's best sellers. The tree branches are represented by rectangles and each sub-branch is shown as a smaller rectangle. The treemap chart displays categories by color and proximity and can easily show lots of data which would be difficult with other chart types.

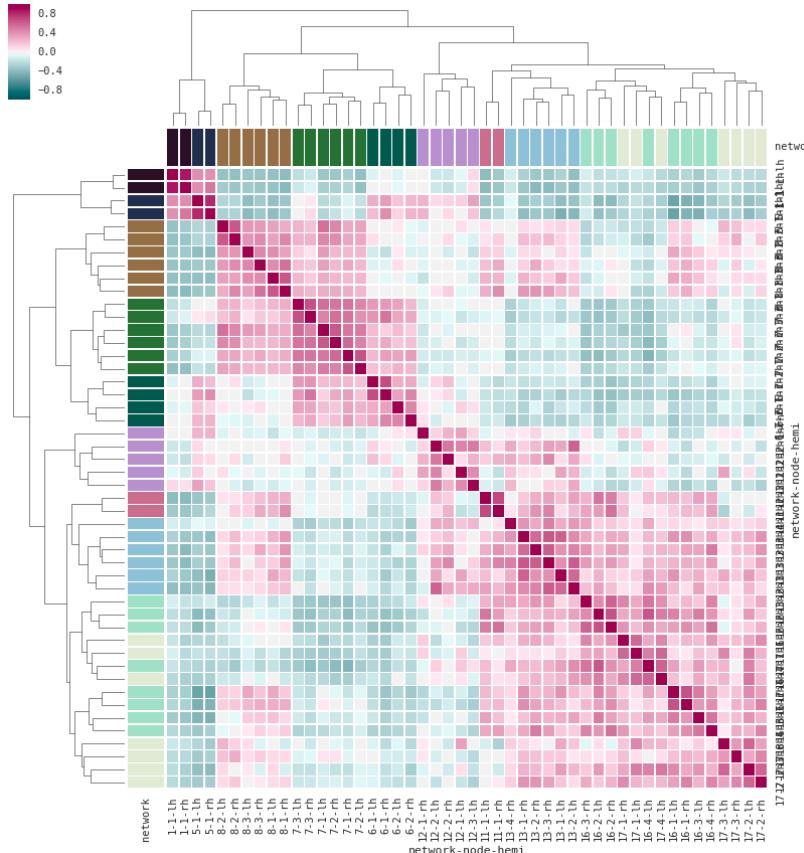
Treemap charts are good for comparing proportions within the hierarchy, however, treemap charts aren't great at showing hierarchical levels between the largest categories and each data point. A sunburst chart is a much better visual chart for showing that.



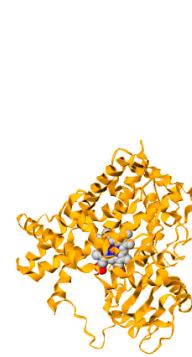
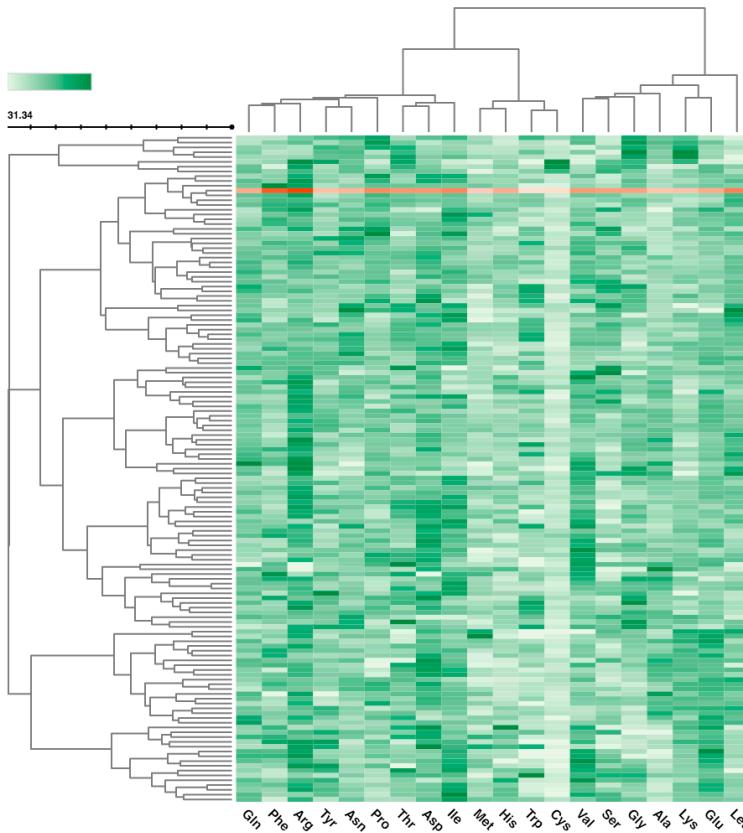
<https://blogs.office.com/2015/07/02/introducing-new-and-modern-chart-types-now-available-in-office-2016-preview/>

CLUSTER HEATMAPS

Juxtaposed Techniques



http://seaborn.pydata.org/examples/structured_heatmap.html

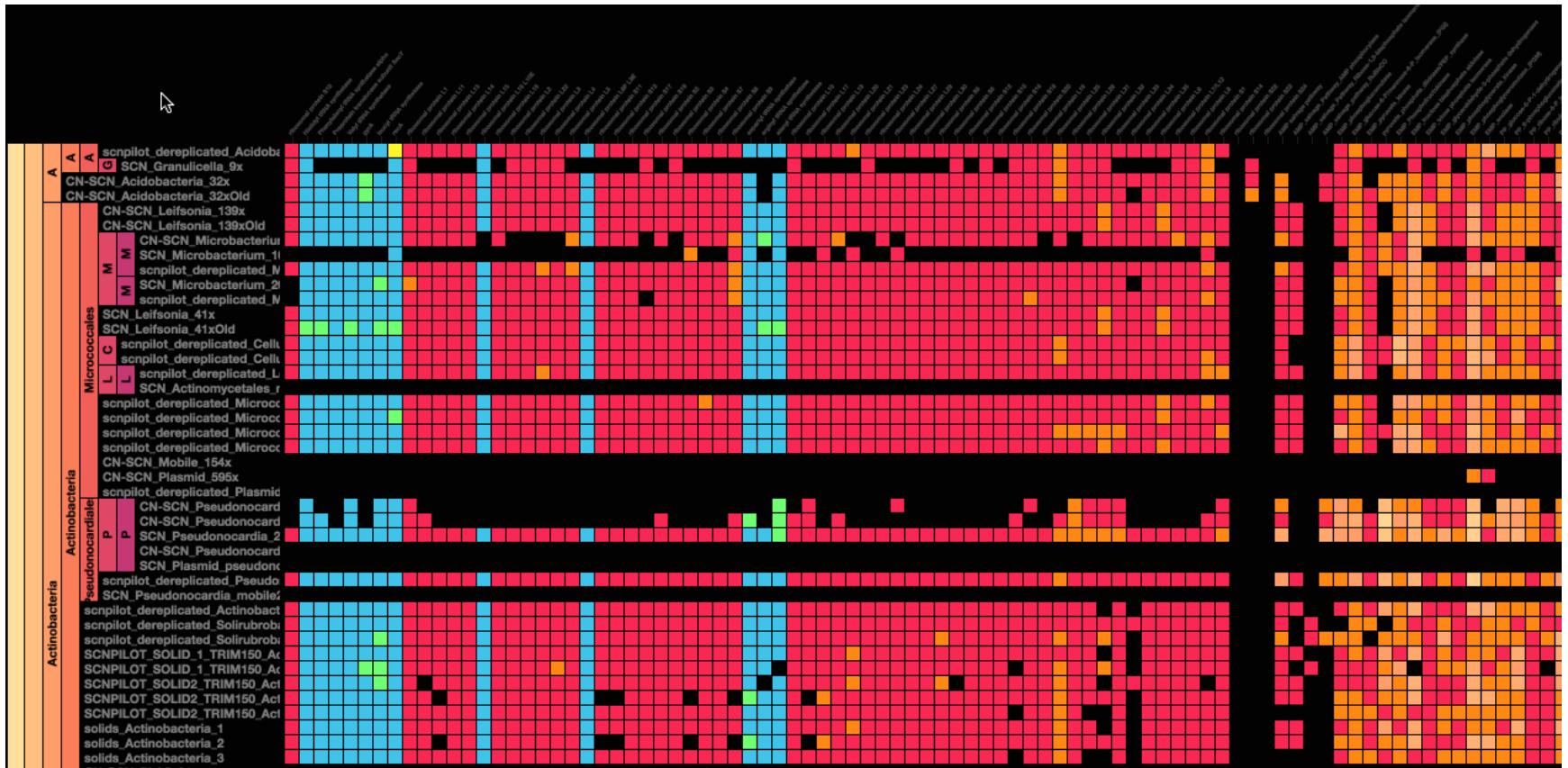


PDB ID	1P05
Structure Title	Structure of mammalian cytochrome P450 2B4
Chain Length	476 residues
Resolution [Å]	1.6
Classification	oxidoreductase
Biological Process	oxidation-reduction process
Cellular Component	endoplasmic reticulum
Molecular Function	monooxygenase activity
Primary citation	
PubMed ID	14563924
DOI	10.1073/pnas.2133986100

<http://www.openscreen.cz/software/inchlib/home/>



<https://bmcbioinformatics.biomedcentral.com/articles/10.1186/s12859-016-1442-6>



<https://stamen.com/work/banfield/>

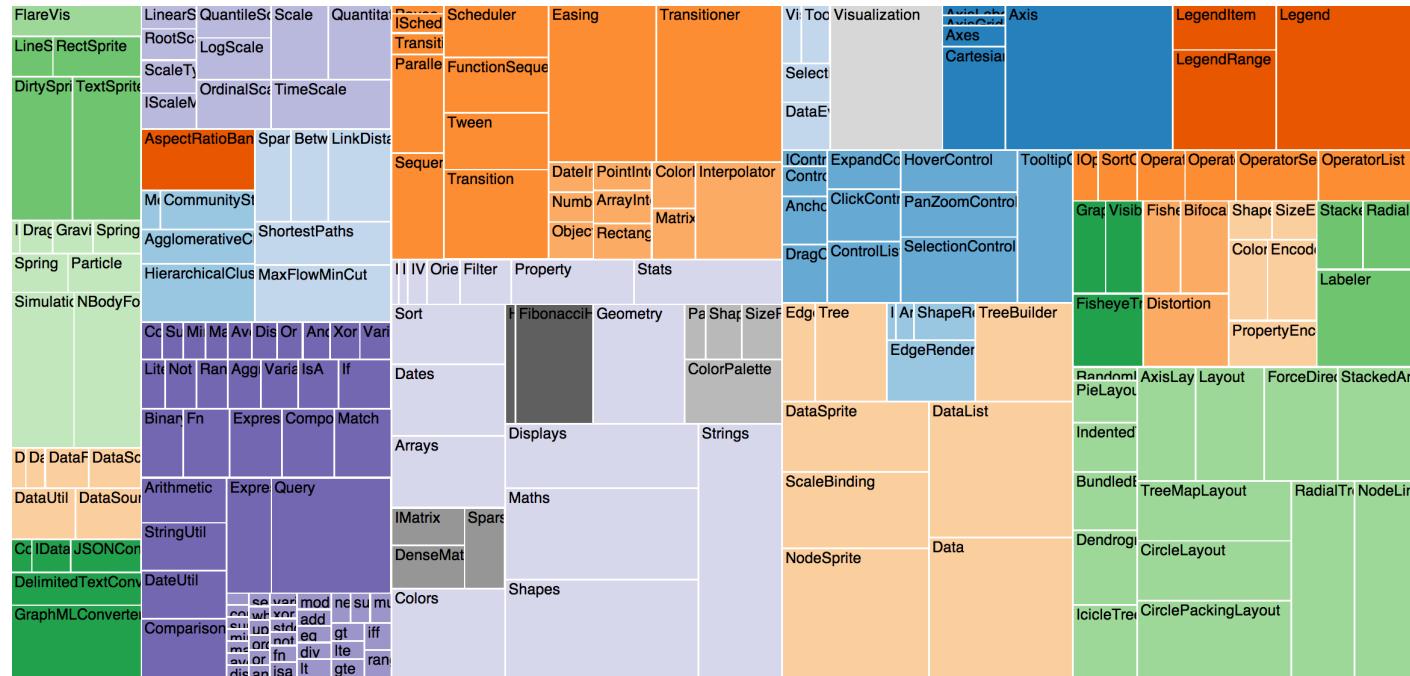
TREEMAPS

Treemaps

- Root is entire rectangle
- Recursively divide rectangles to show levels
- Two common visualization tasks
 - Promote comparison, visualize hierarchy
- Task affects encoding (color, outlines, shading, etc.)

<http://www.cs.umd.edu/hcil/treemap-history/>

Treemaps



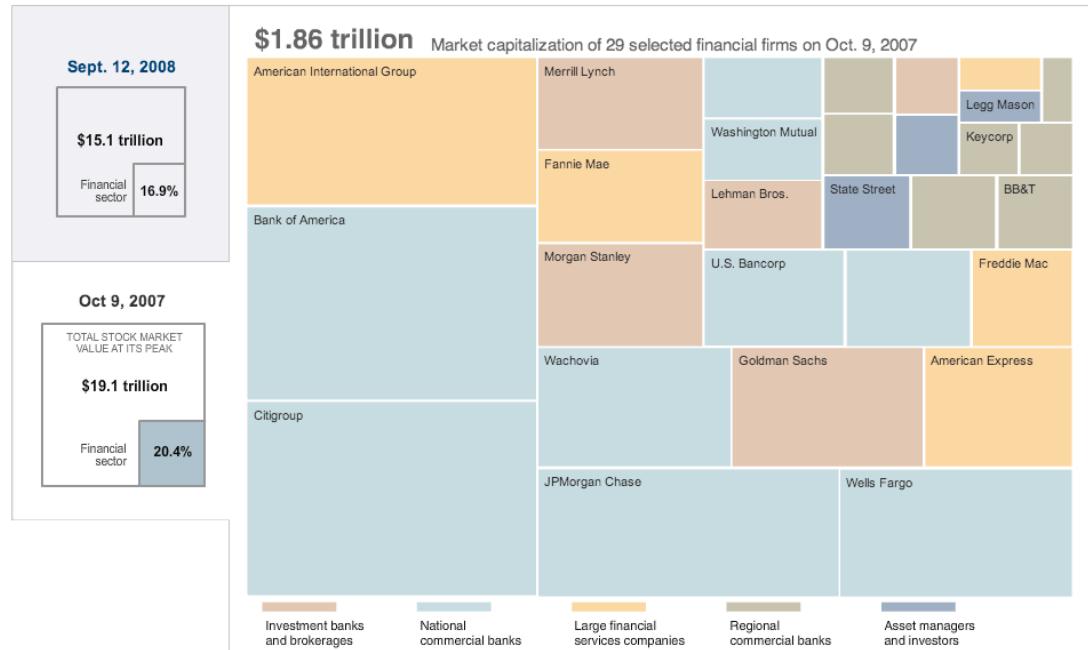
<http://bl.ocks.org/mbostock/4063582>

September 15, 2008

SIGN IN TO E-MAIL OR SAVE THIS | FEEDBACK

A Year of Heavy Losses

A year ago, financial companies were flying high. But as problems in the mortgage and credit markets have grown, the stocks of many Wall Street firms have been hard hit. Some of the biggest companies have been bought out, taken over by the government or gone bankrupt.



These two snapshots of the U.S. stock market and the financial sector are based on the Dow Jones Wilshire 5000 index, the market's broadest measure. Each box represents the market value of one company, which is found by multiplying the number of a company's shares outstanding by its stock price.

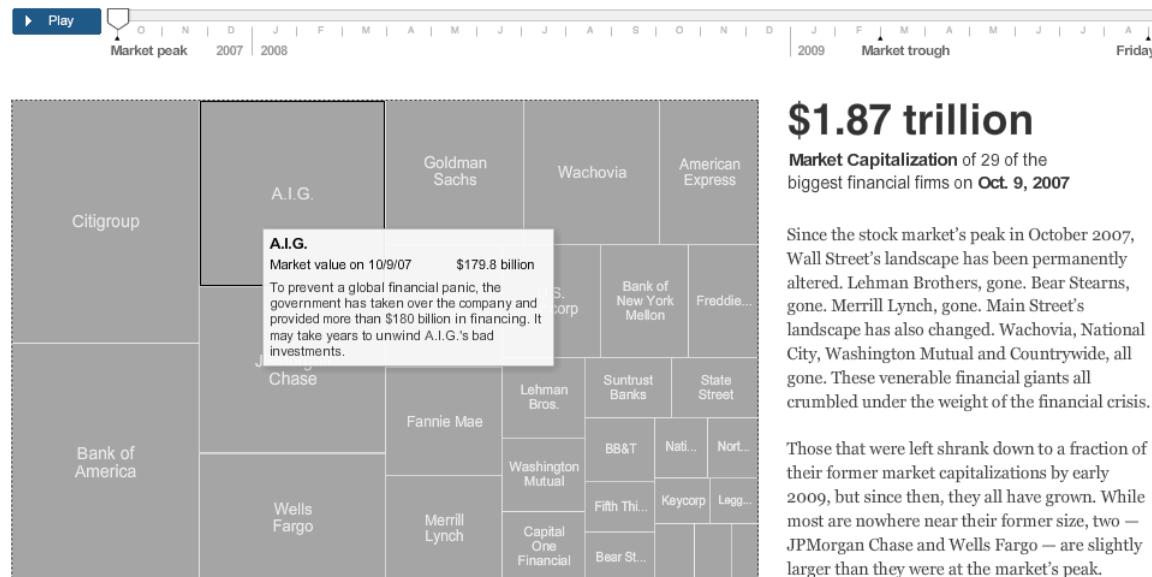
Source: Wilshire Associates

Kevin Quealy and Dylan Loeb McClain / The New York Times

<http://www.nytimes.com/interactive/2008/09/15/business/20080916-treemap-graphic.html>

Published: September 12, 2009

How the Giants of Finance Shrunk, Then Grew, Under the Financial Crisis

By KARL RUSSELL and SHAN CARTER | [Send Feedback](#)

Source: Bloomberg

Correction: September 20, 2009: The Metrics chart last Sunday, showing the changing market capitalization of financial companies, misstated actions taken by Citigroup. It has reorganized into two segments: Citicorp (core businesses) and Citi Holdings (other businesses). It has not set aside those plans.

<http://www.nytimes.com/interactive/2009/09/12/business/financial-markets-graphic.html>

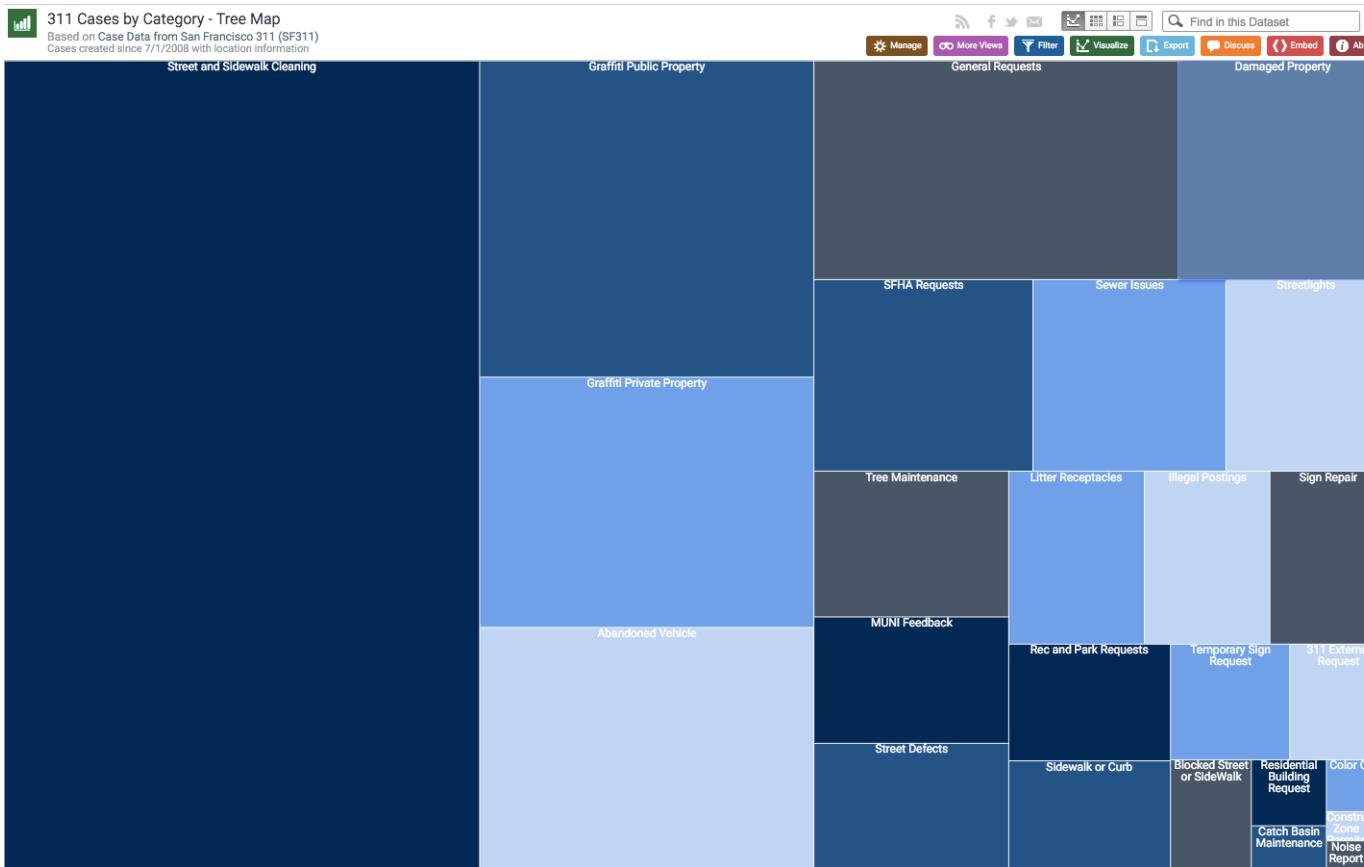




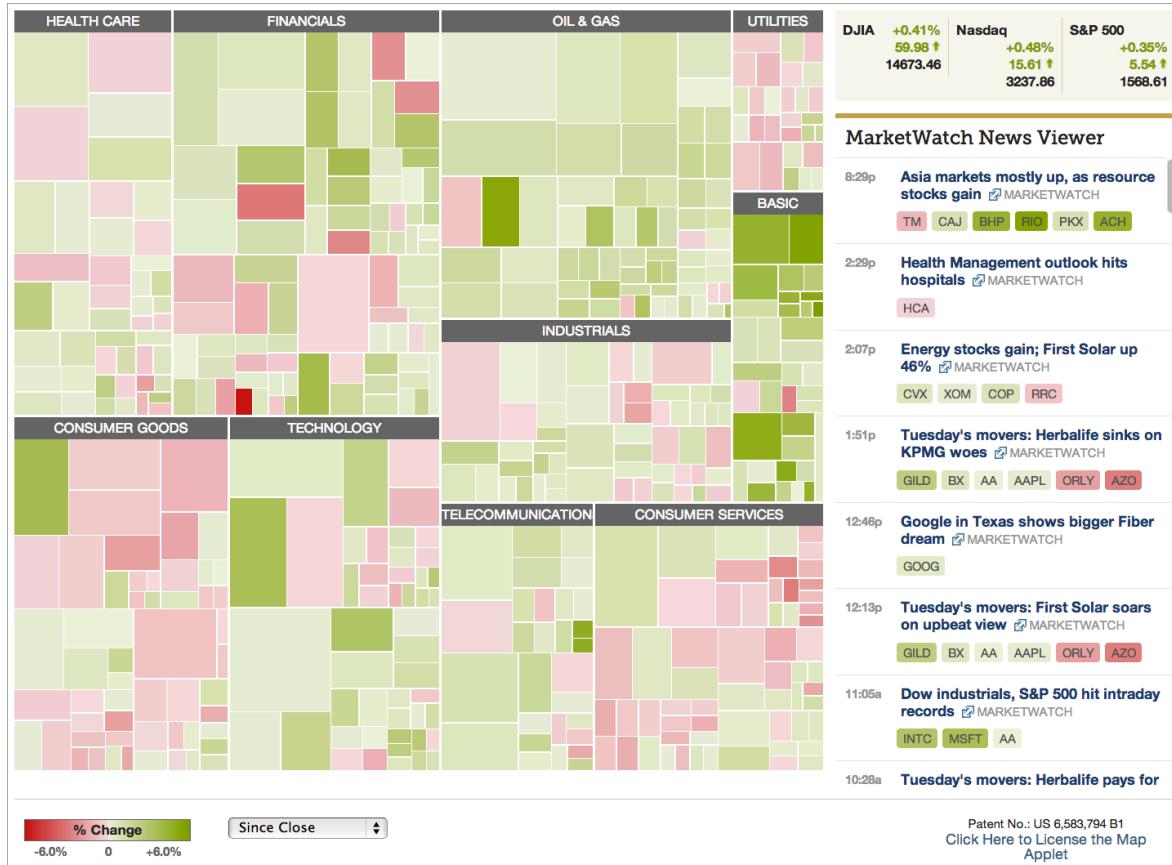
<http://www.informationisbeautiful.net/visualizations/the-billion-dollar-o-gram-2009/>

\$11,900 Worldwide cost of financial crisis

<http://www.informationisbeautiful.net/visualizations/the-billion-dollar-o-gram-2009/>



<https://data.sfgov.org/City-Infrastructure/311-Cases-by-Category-Tree-Map/bf6q-9qjw>



<http://www.smartmoney.com/map-of-the-market/>

Cushion Treemaps

In this example a static JSON tree is loaded into a Cushion Treemap.

Left click to set a node as root for the visualization.

Right click to set the parent node as root for the visualization.

You can choose a different tiling algorithm below:

Squareified

Strip

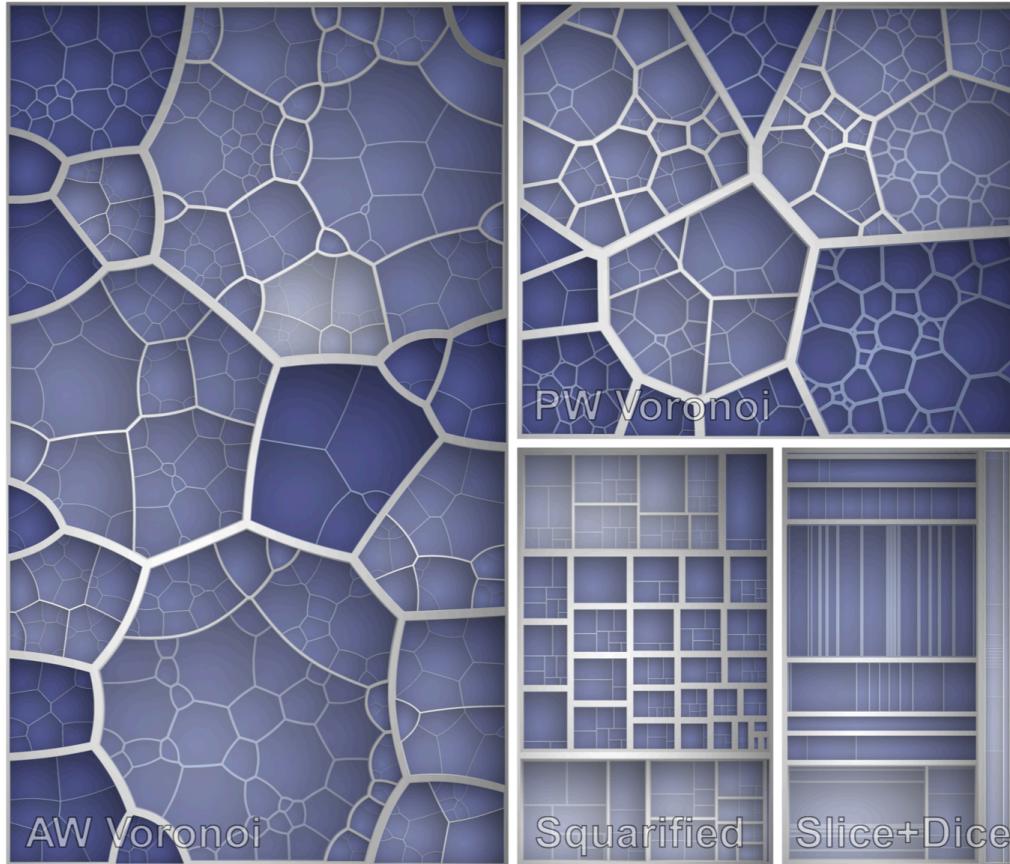
SliceAndDice

[Go to Parent](#)

[See the Example Code](#)

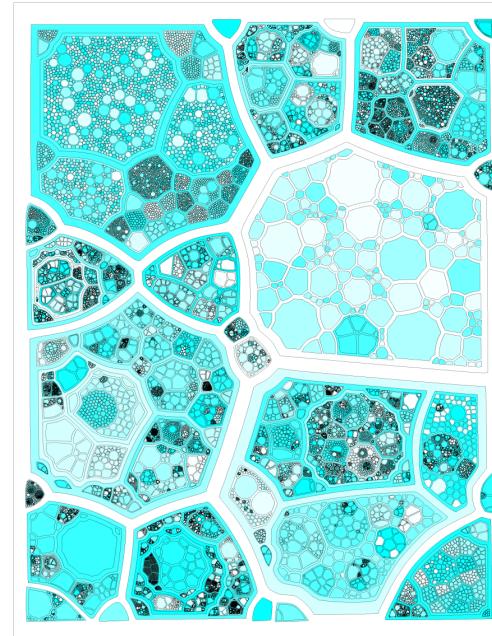
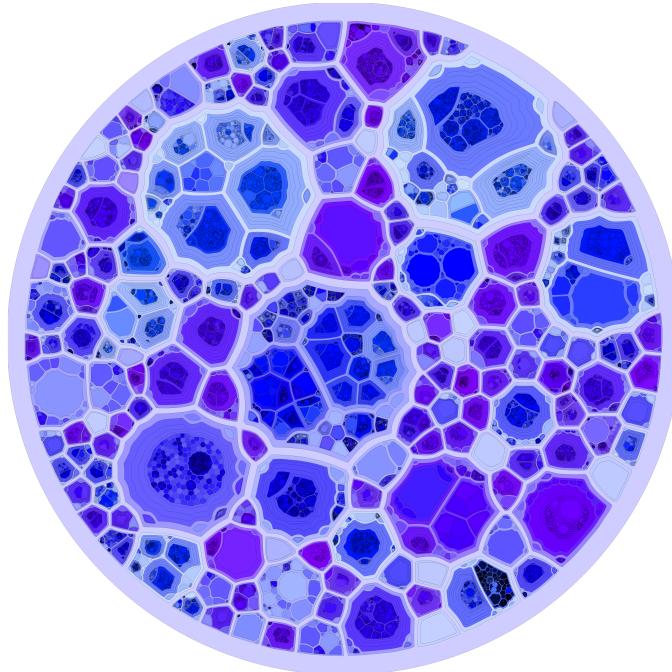


<http://philobg.github.io/jit/static/v20/Jit/Examples/Treemap/example3.html>



<http://www.informatik.uni-konstanz.de/en/deussen/publications/>

Voronoi Treemaps



<http://graphics.uni-konstanz.de/~deussen/php/voronoitreemaps.php>



<http://www.nature.com/ncomms/journal/v1/n9/full/ncomms1137.html>

 ZOOM IN  ZOOM OUT

Food and beverages 15%

The high price of oil is a factor that has made food prices rise quickly.

Miscellaneous 3%

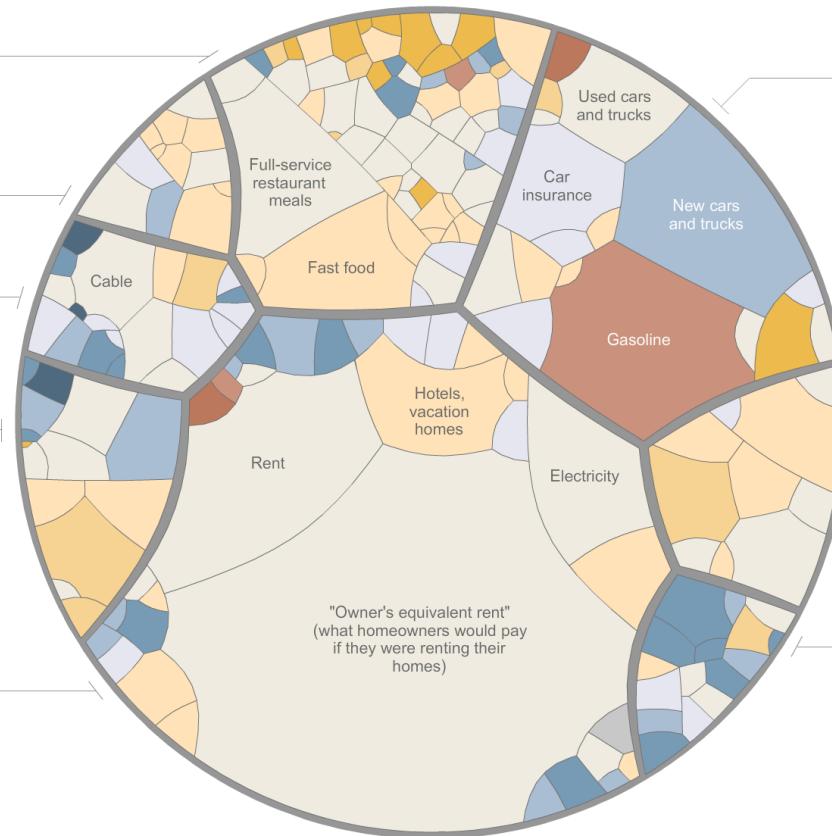
Recreation 6%

Education/Communication 6%

Cellphones were added to the index in 1997. Because the Consumer Price Index can be slow to add new goods, which are often cheaper, it may overstate parts of inflation.

Housing 42%

In the C.P.I., home ownership costs track rent prices more closely than housing prices. This means inflation may have been understated when home prices were rising faster than rents.



Transportation 18%

Gas is 5.2 percent of spending nationwide, but only 3.8 percent in the New York area.

Health care 6%

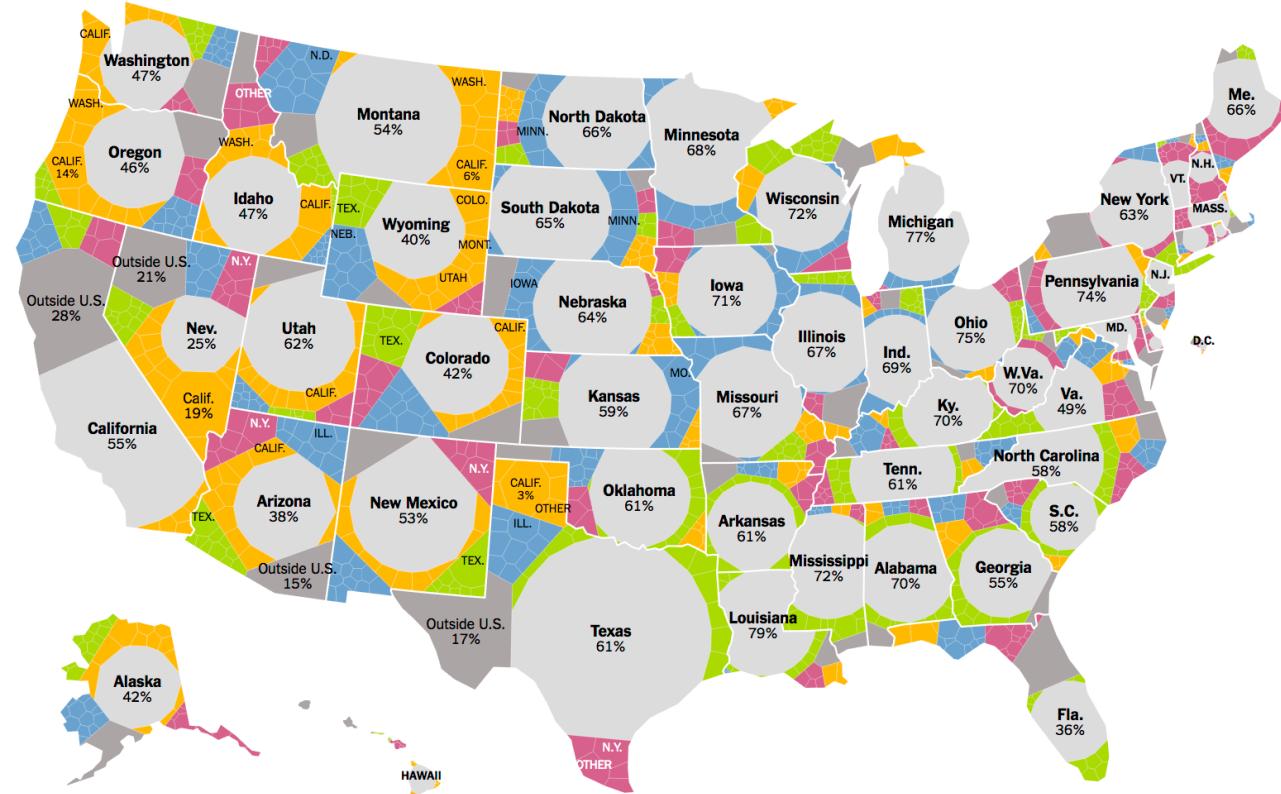
As a group, the elderly spend about twice as much of their budget on medical care.

Apparel 4%

The ratio of spending on women's clothes to that on men's clothes is about 2 to 1.

http://www.nytimes.com/interactive/2008/05/03/business/20080403_SPENDING_GRAPHIC.html

Northeast South Midwest West Outside the U.S.*



<https://www.nytimes.com/2014/08/16/upshot/mapping-migration-in-the-united-states-since-1900.html>