The background features a dark, textured surface with a faint silhouette of a human head in profile, facing right. Inside the head, there are concentric circles and a central point, suggesting a brain or a data processing center. Scattered throughout the background are various elements: binary code (0s and 1s) in a light blue/grey color, some numbers (2, 3, 6, 9) in a similar color, and several wavy lines in yellow and blue. Some of these lines are dotted and labeled 'data'. The overall aesthetic is high-tech and data-oriented.

MADAB

DATA VISUALIZATION

HIERARCHICAL DATA

Instructor: Rossano Schifanella

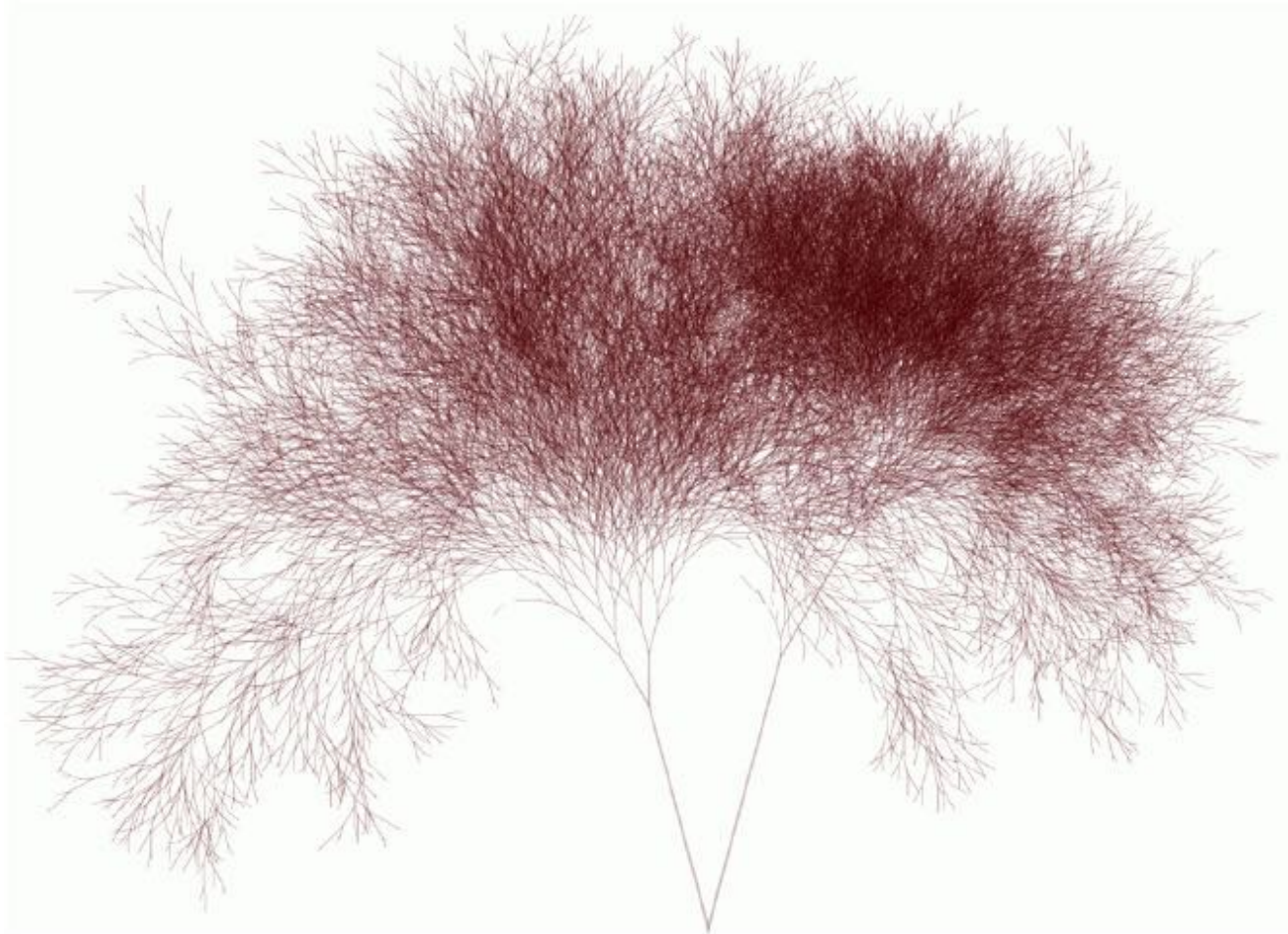
Hierarchical Data

- Any data with some sort of hierarchy
 - *"Group of objects ranked so that everyone but the top most is subordinate to one above it."*
- Example hierarchy
 - Country: Italy
 - Region: Piedmont
 - Area: Turin
 - City: Turin
 - Municipal District: Madonna di Campagna

Examples of Hierarchical Data

- Evolutionary Tree
- Dendrograms
- File Directory Structure
- Dewey Decimal System
- Family History
- Organization Charts
- Outlines

Tree Structures



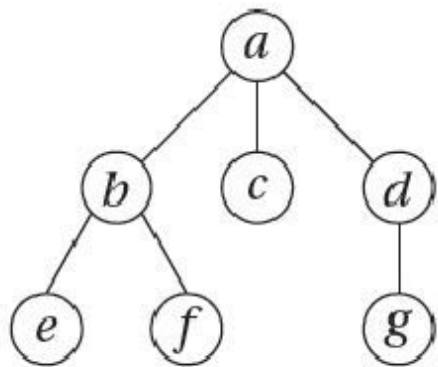
<http://drunkmenworkhere.org/219>

Tree Structures

- 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**)

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 Visualization

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

Considerations

- Is the hierarchical structure visible?
- What is the level of a specific node?
- What is the height of the tree?
- How many nodes on level x ?
- Are the labels readable? All nodes visible?
- What type of interaction is supported?
 - Focus + Context
 - Overview + Detail
 - Zoom + Filter

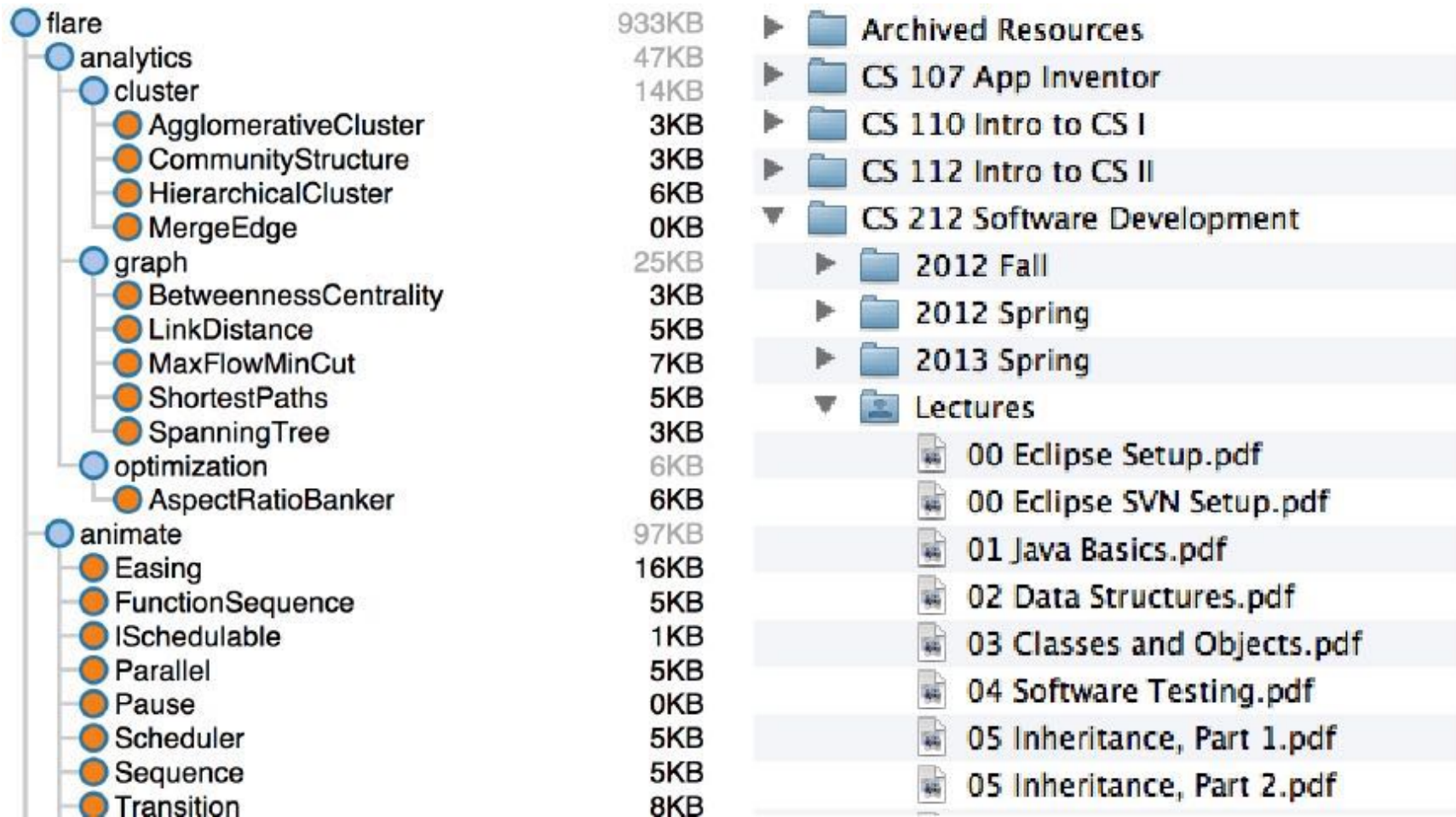
NODE-LINK DIAGRAMS

Tree Visualization

Node-Link Diagrams

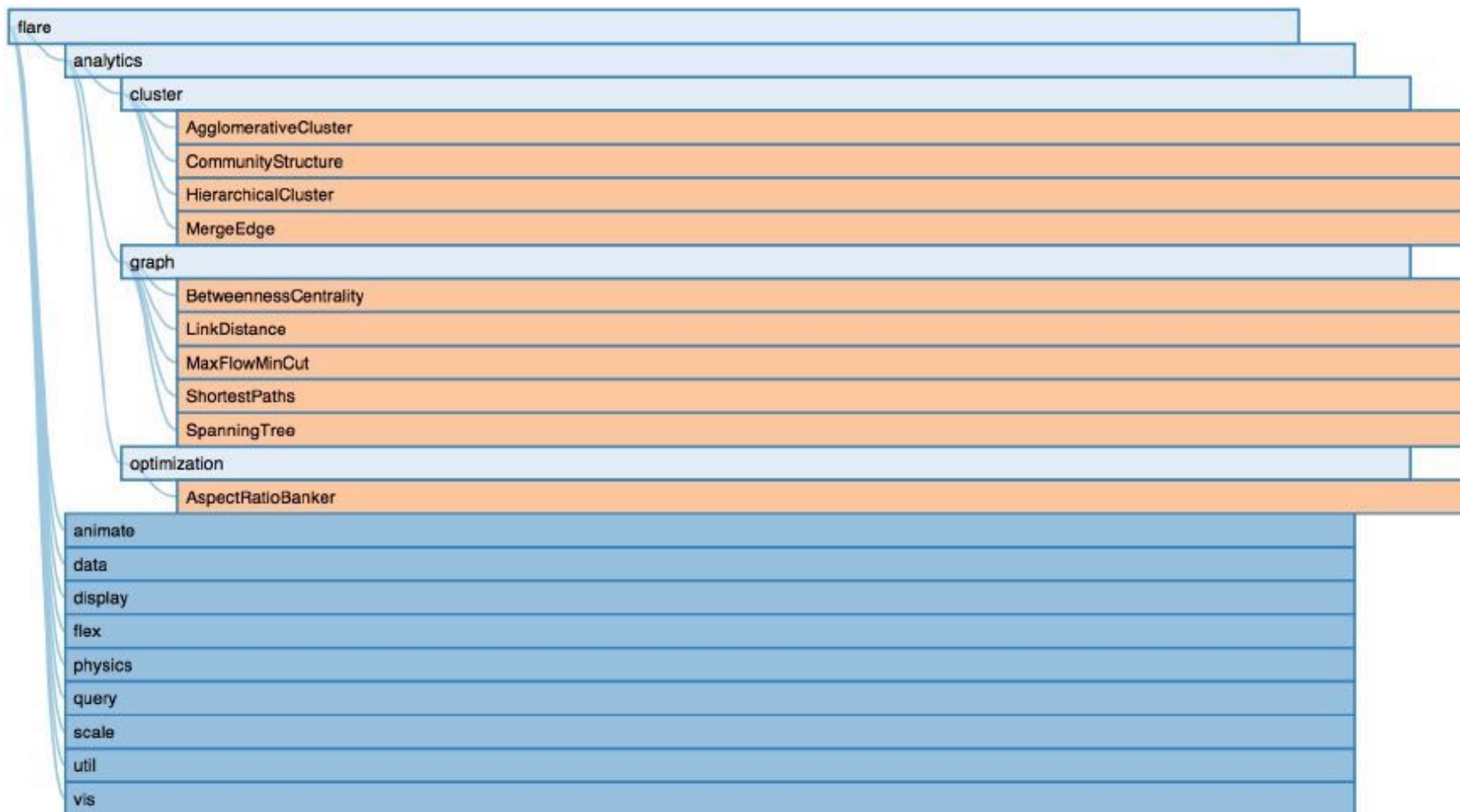
- Indented Layout
 - Child nodes placed below parent and indented
 - Compact width
 - Height expands and shrinks
 - Often used to navigate file systems
 - Difficult to see all nodes of a specific level

Indented Layout



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

Indented Layout

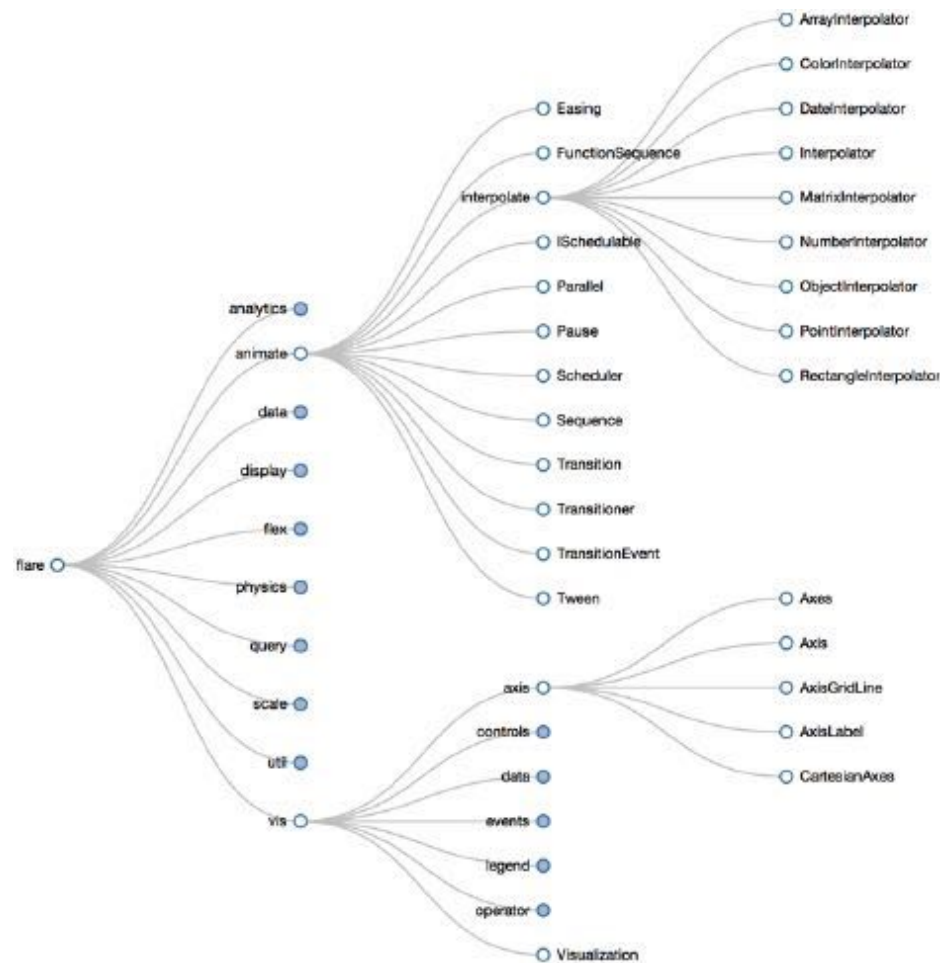


<http://bl.ocks.org/mbostock/1093025>

Node-Link Diagrams

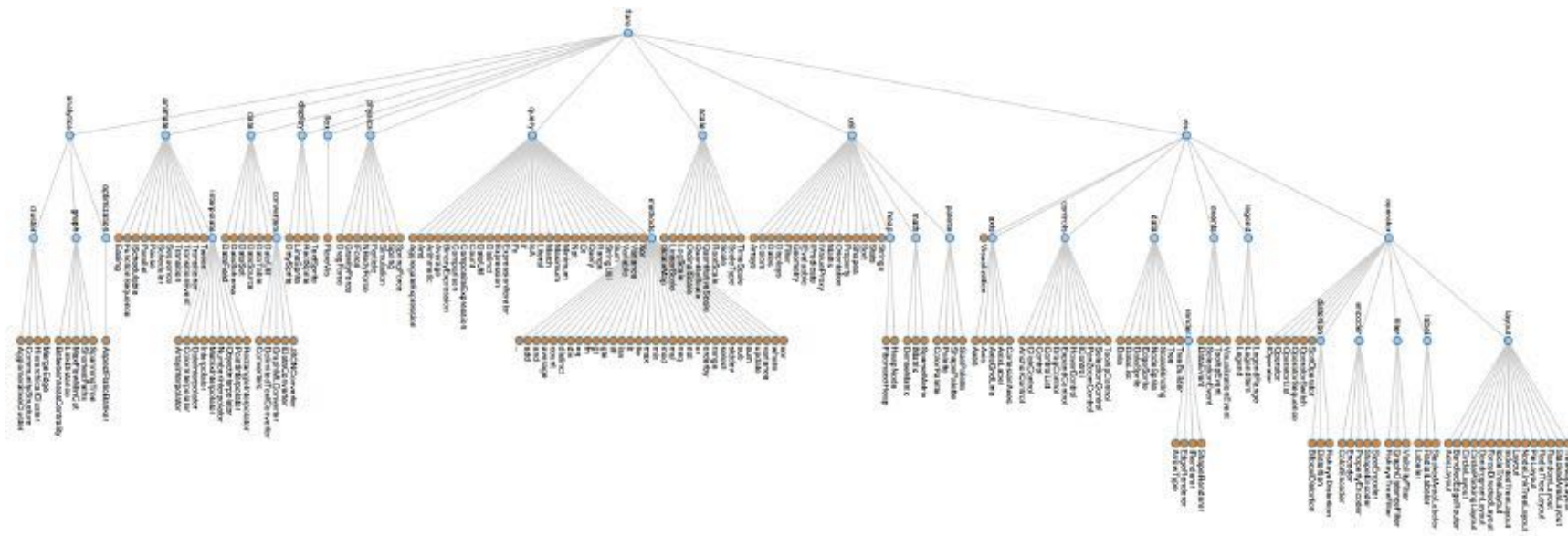
- Traditional Layout
 - Nodes laid out by level, root at top
 - Edges connect adjacent nodes
- Dendrogram
 - All leaves at bottom of diagram
 - Edges usually drawn with sharp corners
 - Often used to show clusters
(sometimes called cluster layout)

Traditional Layout



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

Traditional Layout

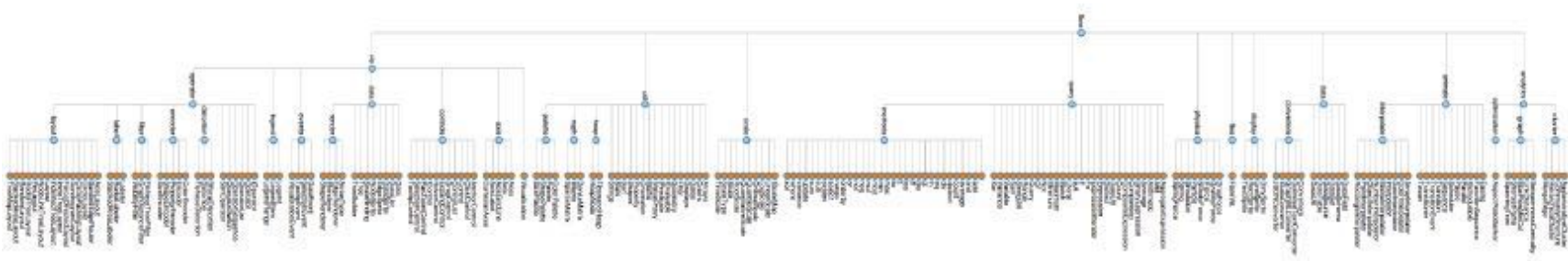


The Flare package tree laid out in horizontal layers. All the nodes in a given layer are at the same package depth.

Source: Flare Visualization Toolkit

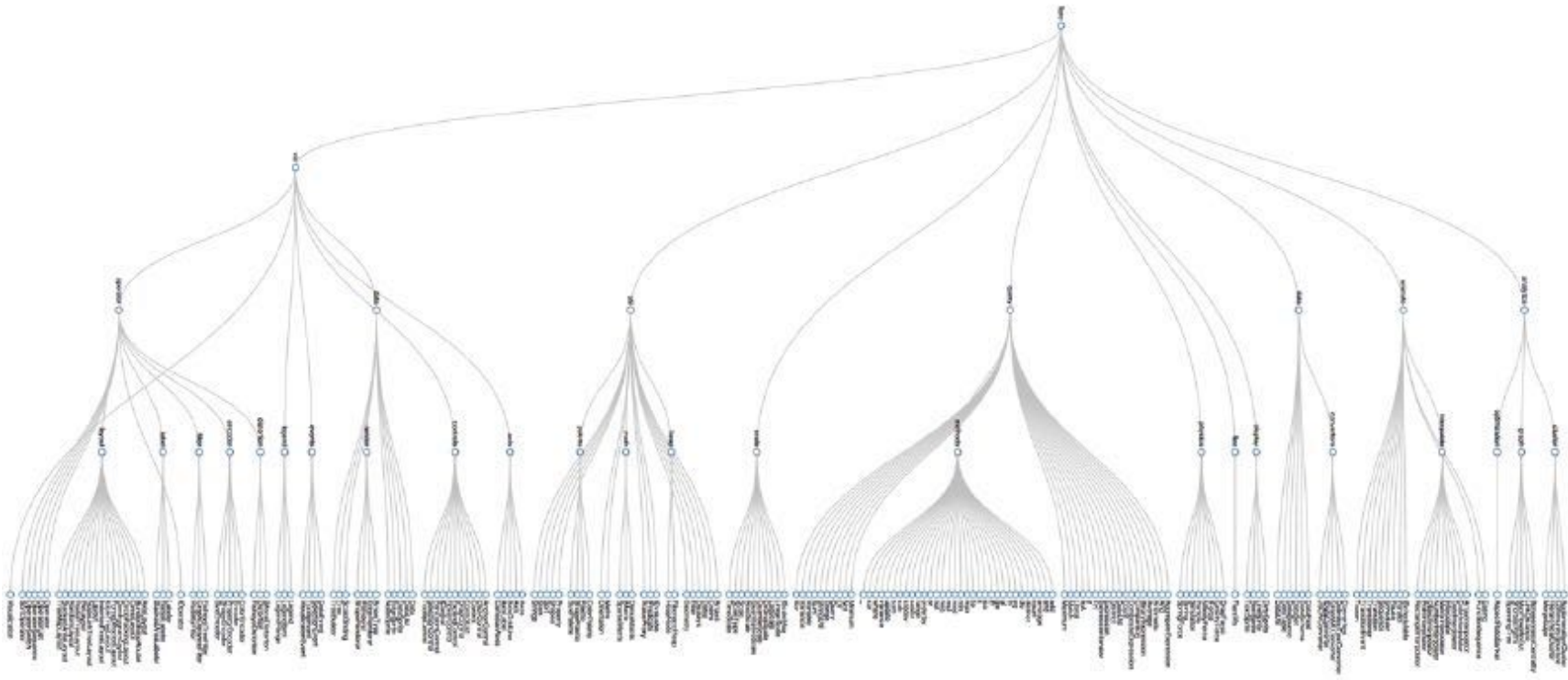
<http://hci.stanford.edu/jheer/files/zoo/ex/hierarchies/tree.html>

Dendrogram



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

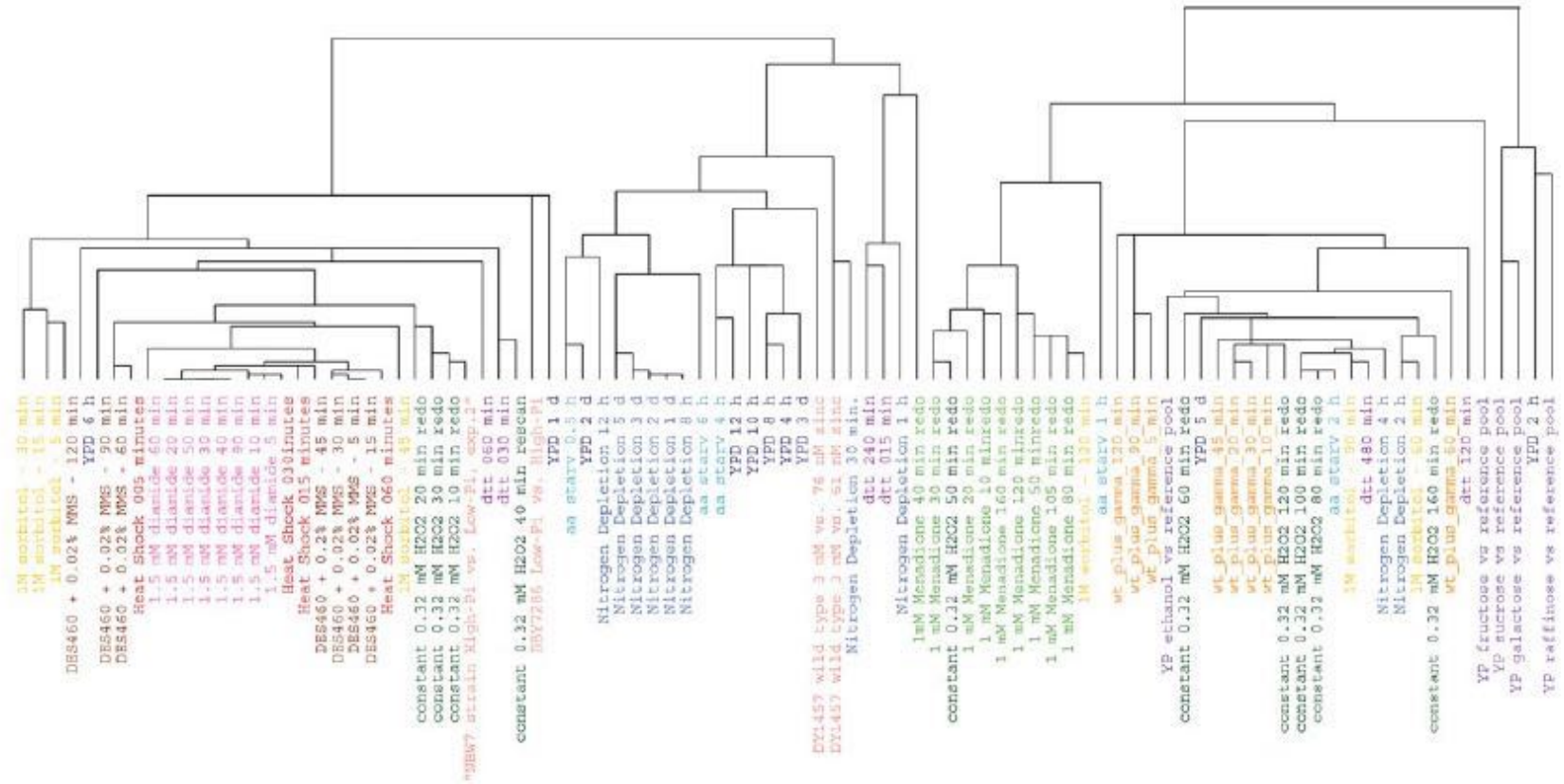
Dendrogram



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

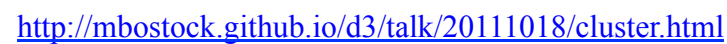
Dendrogram

Cluster 11: protein folding chaperones

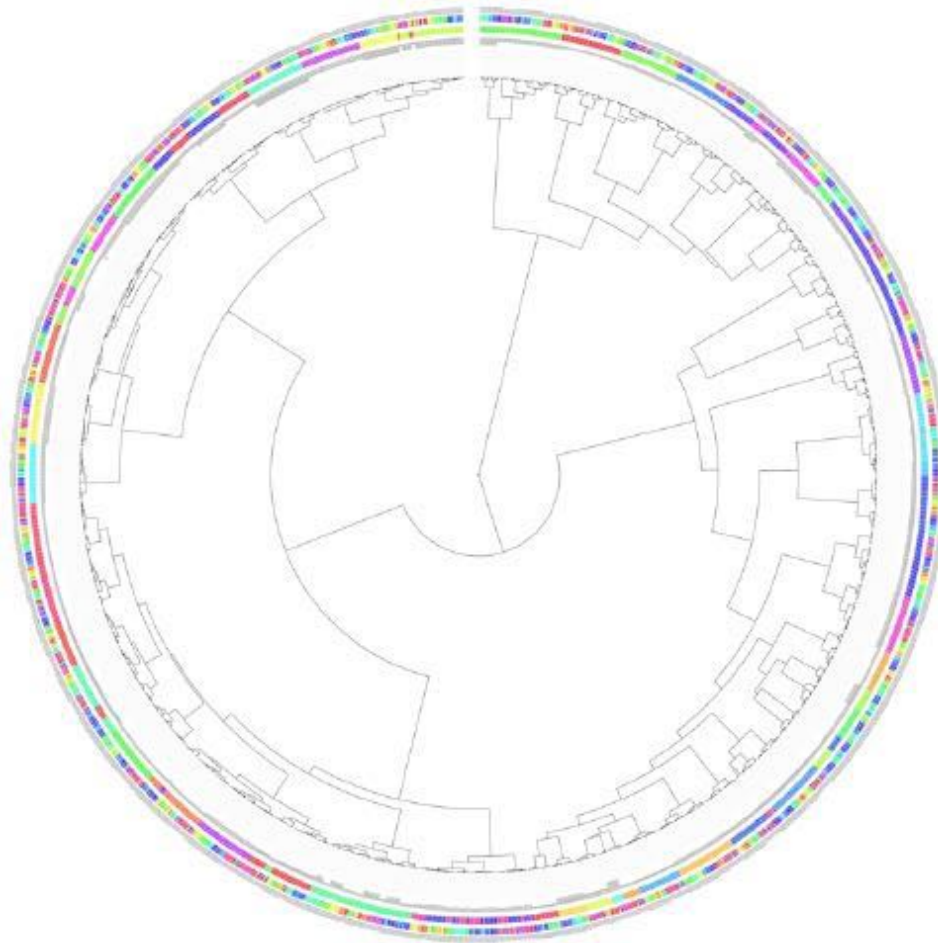




<http://bl.ocks.org/mbostock/4063550>

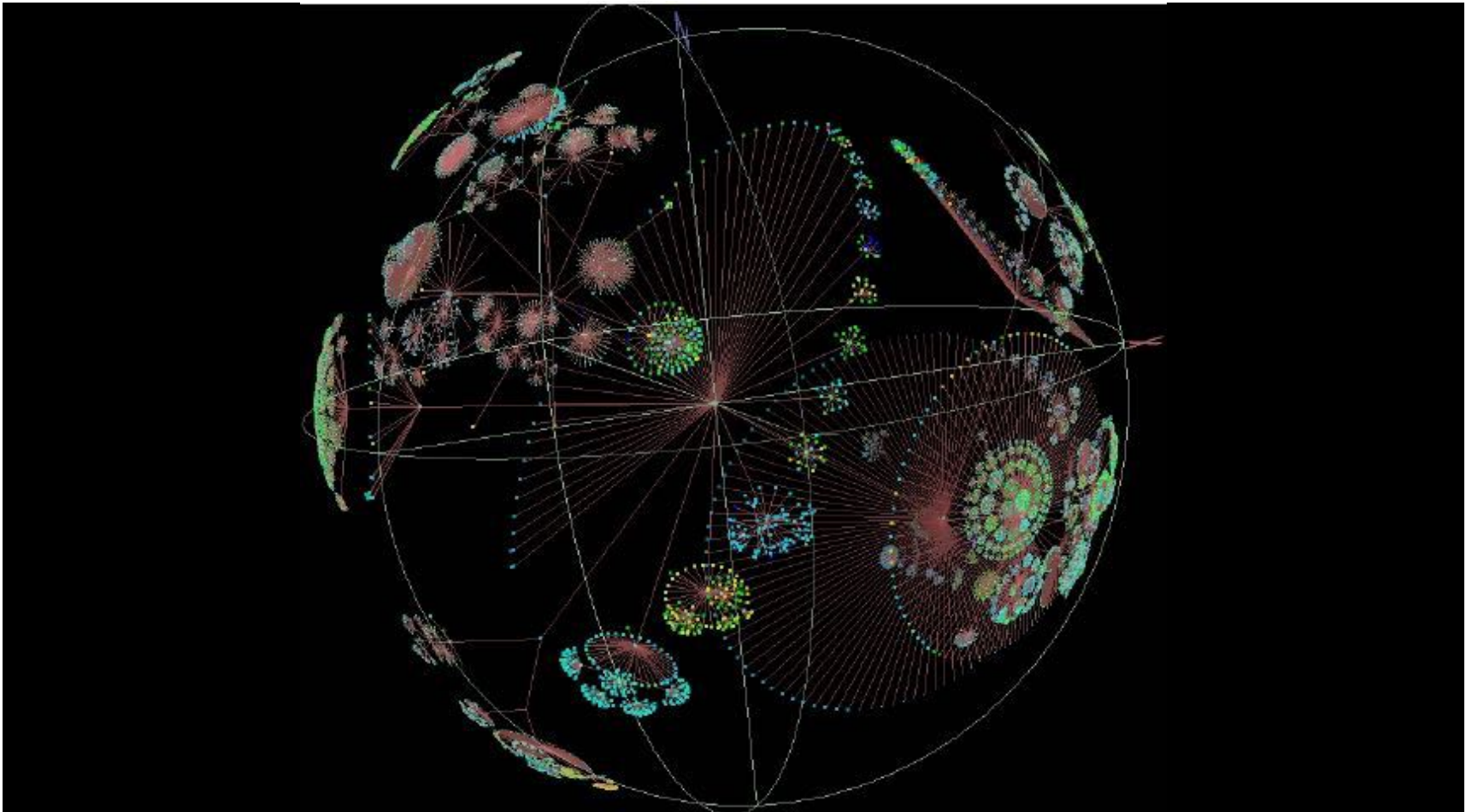


Circular Dendrogram



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

Hyperbolic Tree (3D)

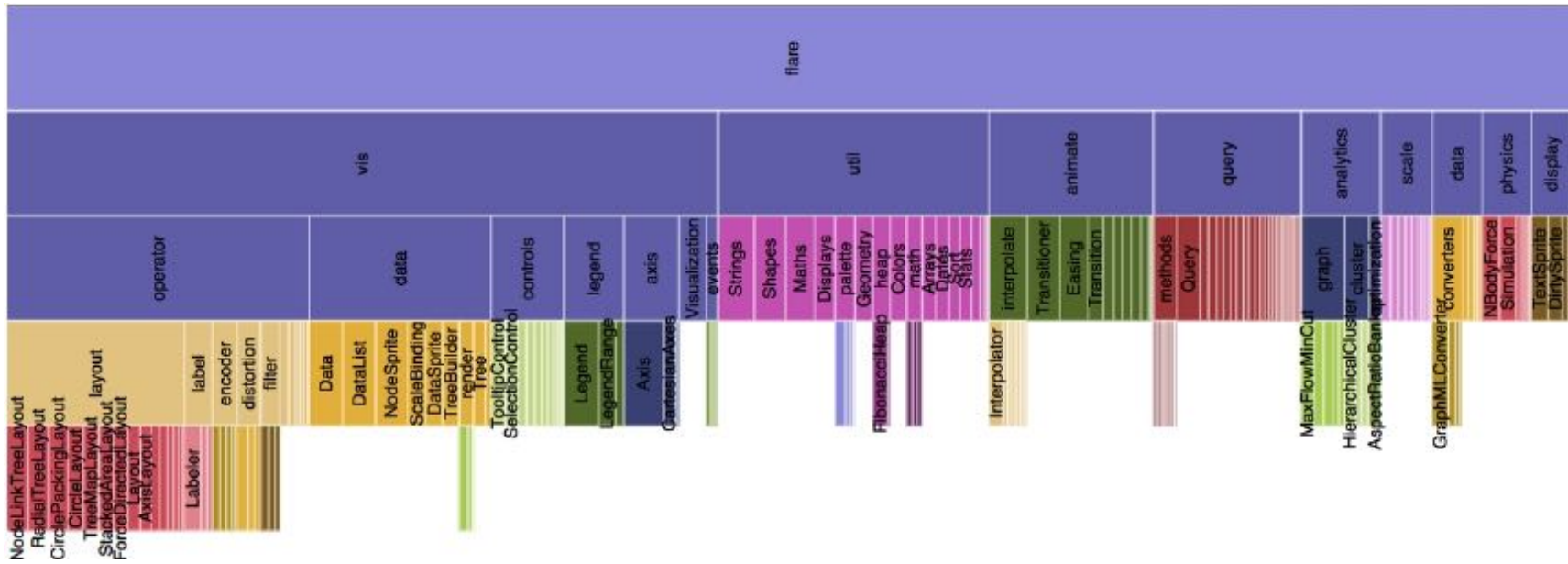


<http://www.caida.org/tools/visualization/walrus/>

SPACE-FILLING DIAGRAMS

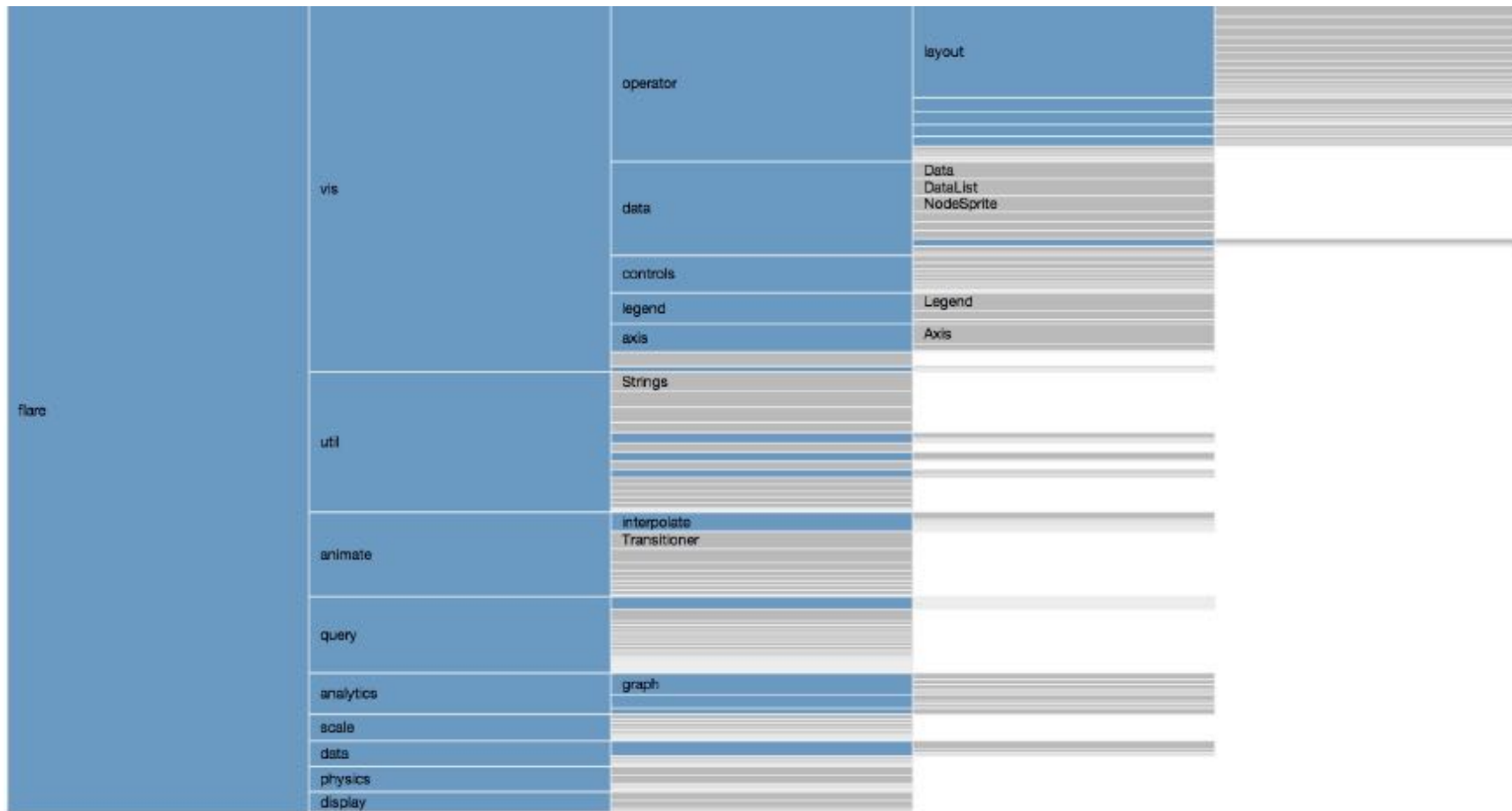
Tree Visualization

Icicle Diagram



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

Icicle Diagram



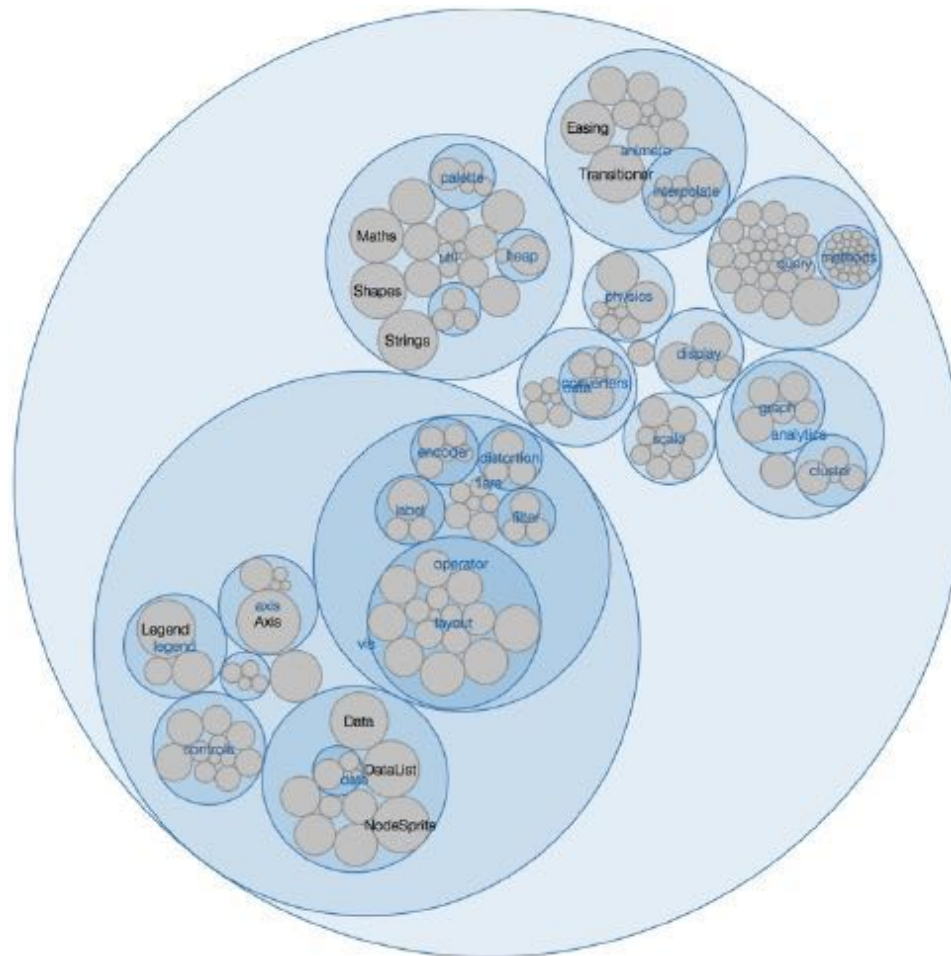
<http://mbostock.github.io/d3/talk/20111018/partition.html>

Sunburst Diagram



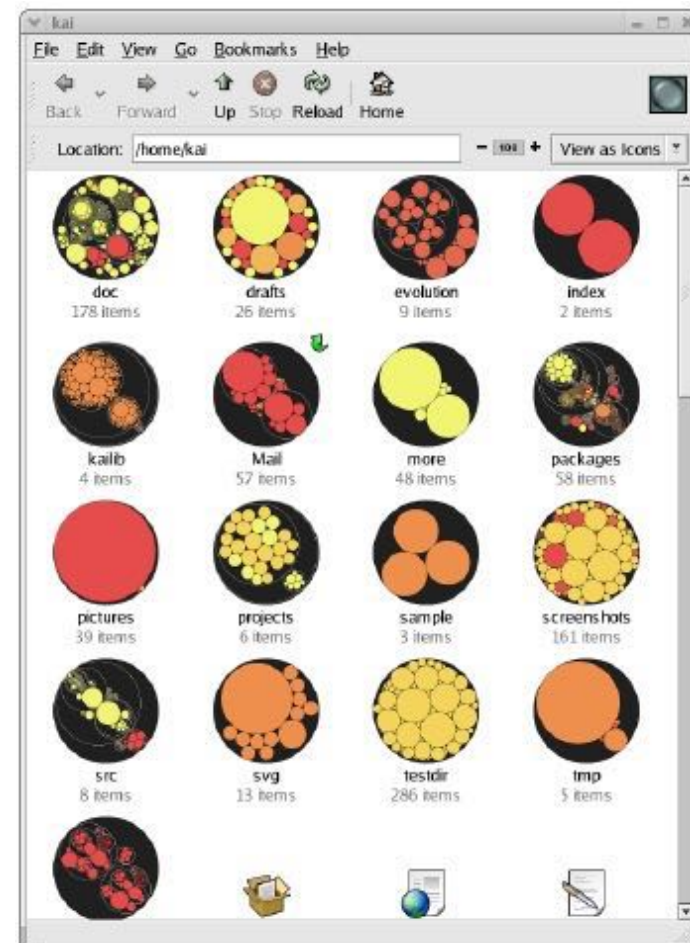
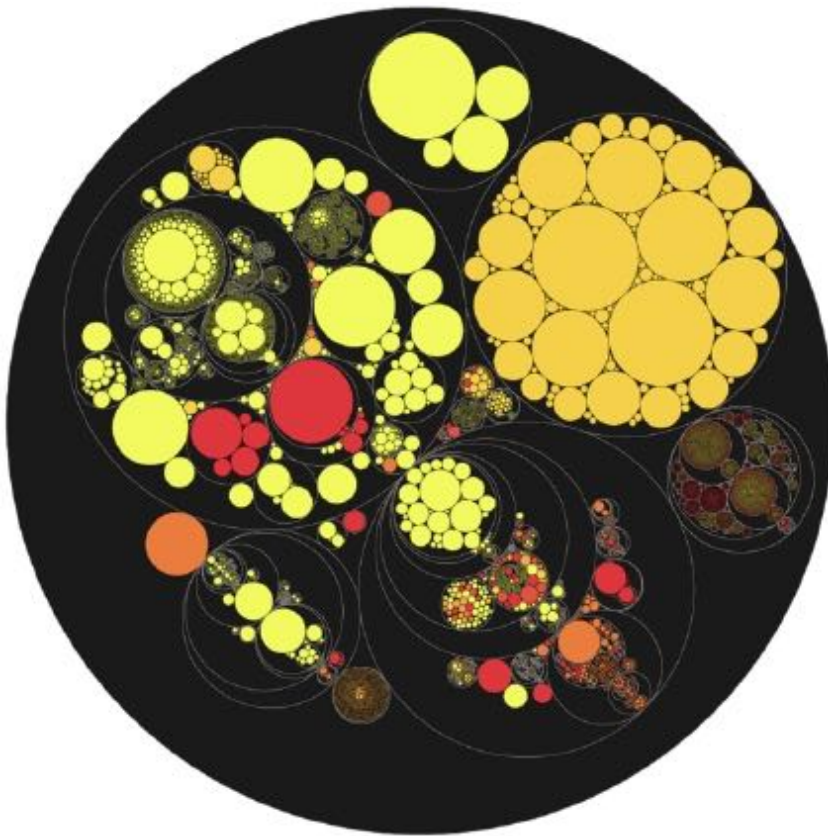
<http://bl.ocks.org/mbostock/4063423>

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

TREEMAPS

Space-Filling Diagrams

Treemaps

- Root is entire rectangle
- Recursively divide rectangles to show levels
- Two common visualization tasks
 - Promote comparison
 - Visualize hierarchy
- Task affects encoding
 - Use of color, outlines, shading, etc.
- See <http://www.cs.umd.edu/hcil/treemap-history/>

Treemaps



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

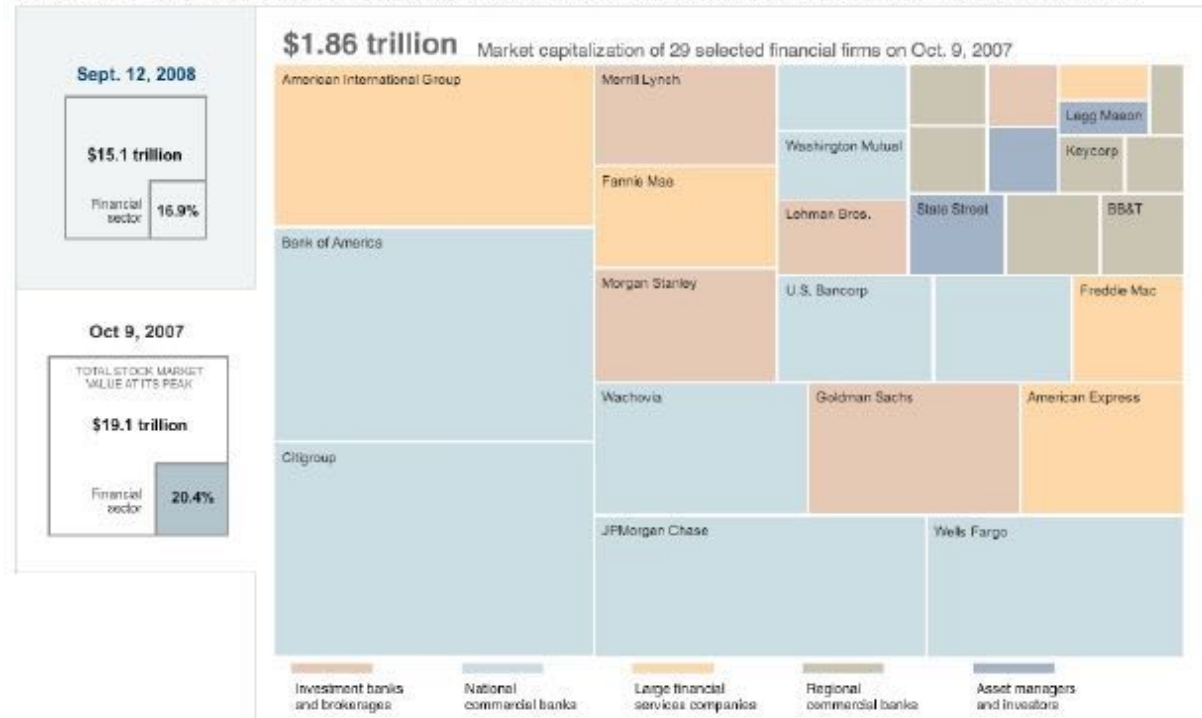
A Year of Heavy Losses

September 15, 2008

SIGN INTO 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.



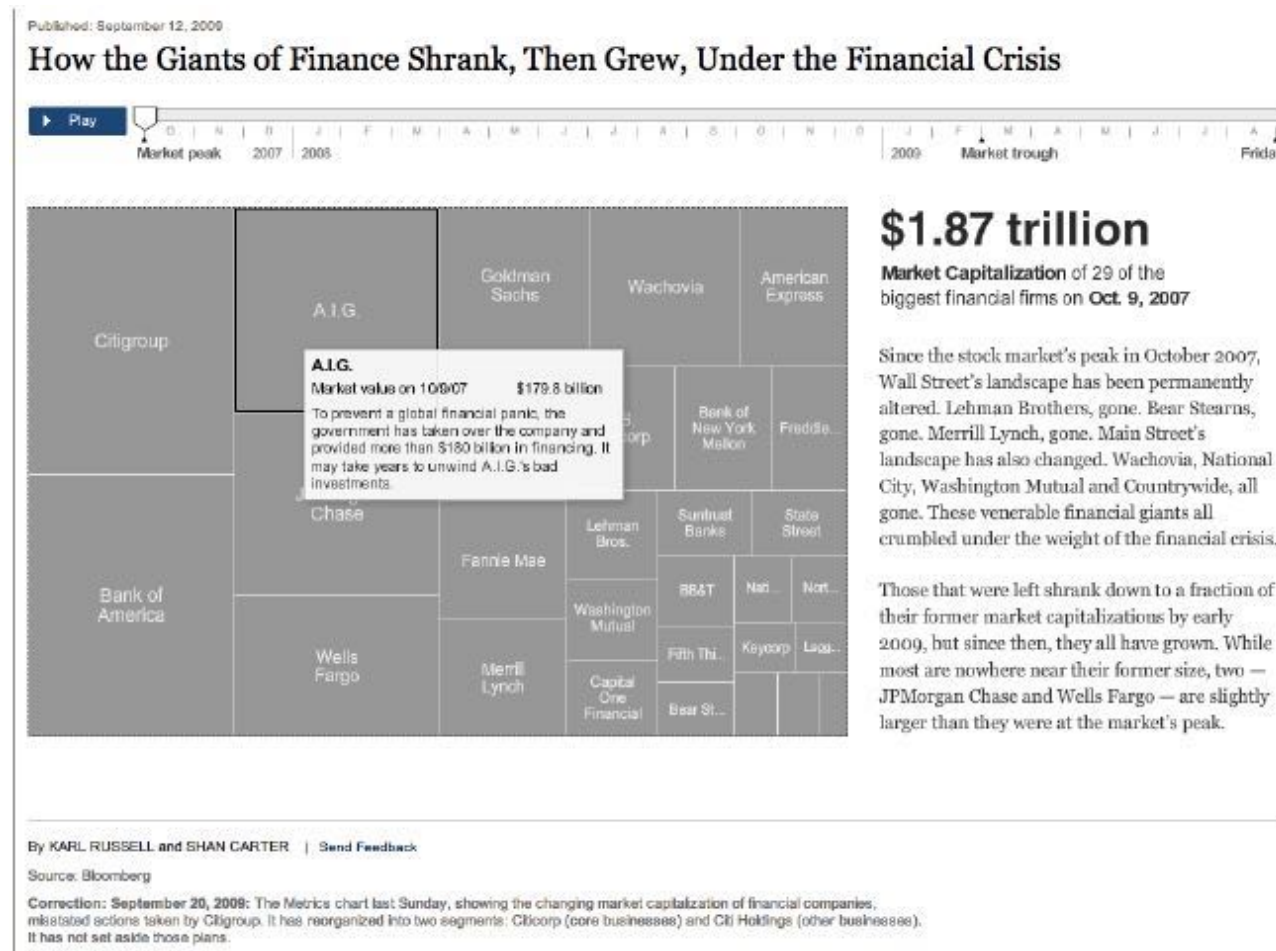
These two snapshots of the U.S. stock market and the financial sector are based on the Dow Jones Wilshire 5000 index, the market's broadest measure. Each box represents the market value of one company, which is found by multiplying the number of a company's shares outstanding by its stock price.

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>

How the Giants of Finance Shrank



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

Billion-Dollar-O-Gram



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

Billion-Dollar-O-Gram



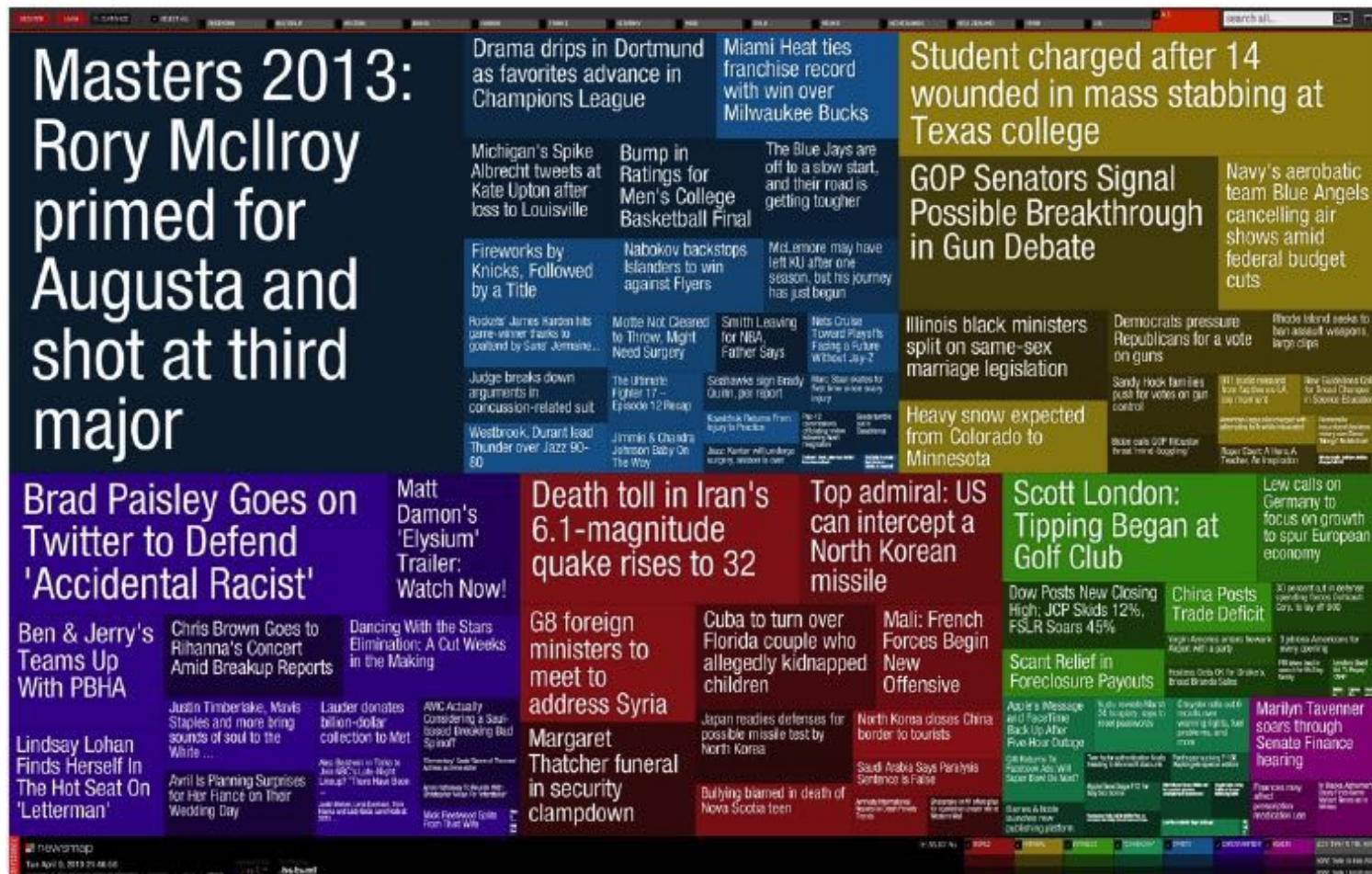
<http://www.informationisbeautiful.net/visualizations/the-billion-dollar-o-gram-2009/>

Map of the Market



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

News Map



<http://newsmap.jp/>

Cushion Treemap

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:

Squarified ☒
 Strip ☐
 SliceAndDice ☐

Go to Parent

[See the Example Code](#)

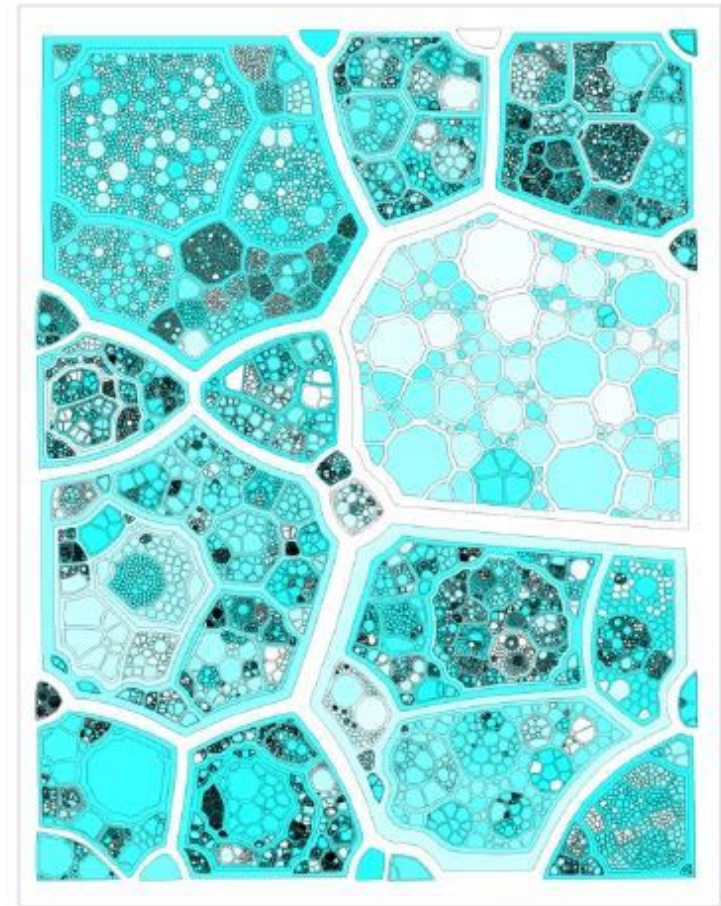
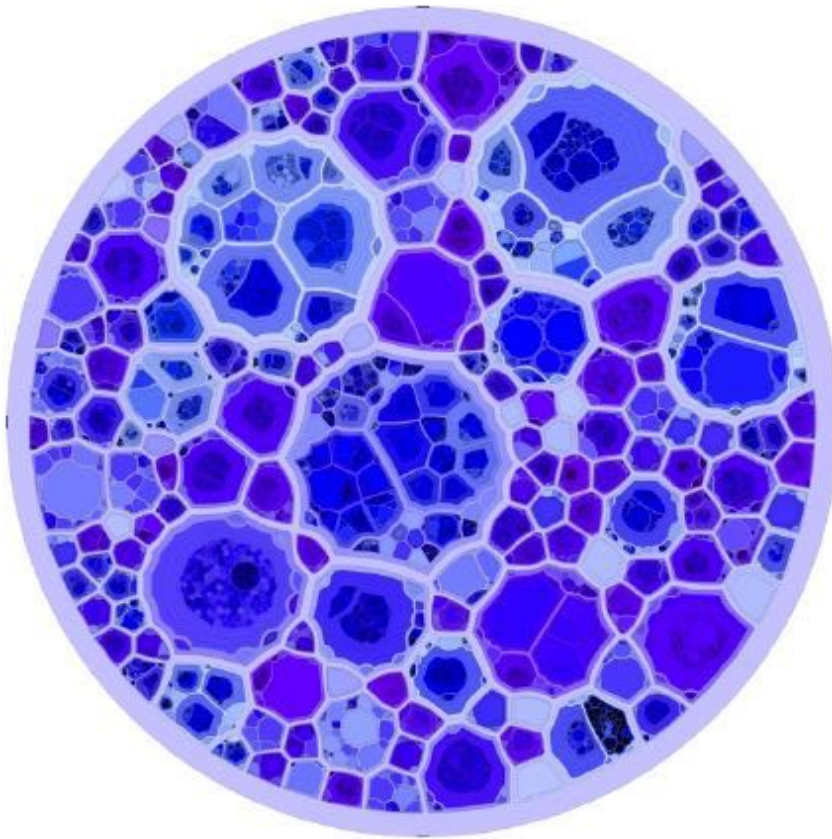


<http://philogb.github.io/jit/static/v20/Jit/Examples/Treemap/example3.html>

Voronoi Treemaps



Voronoi Treemaps



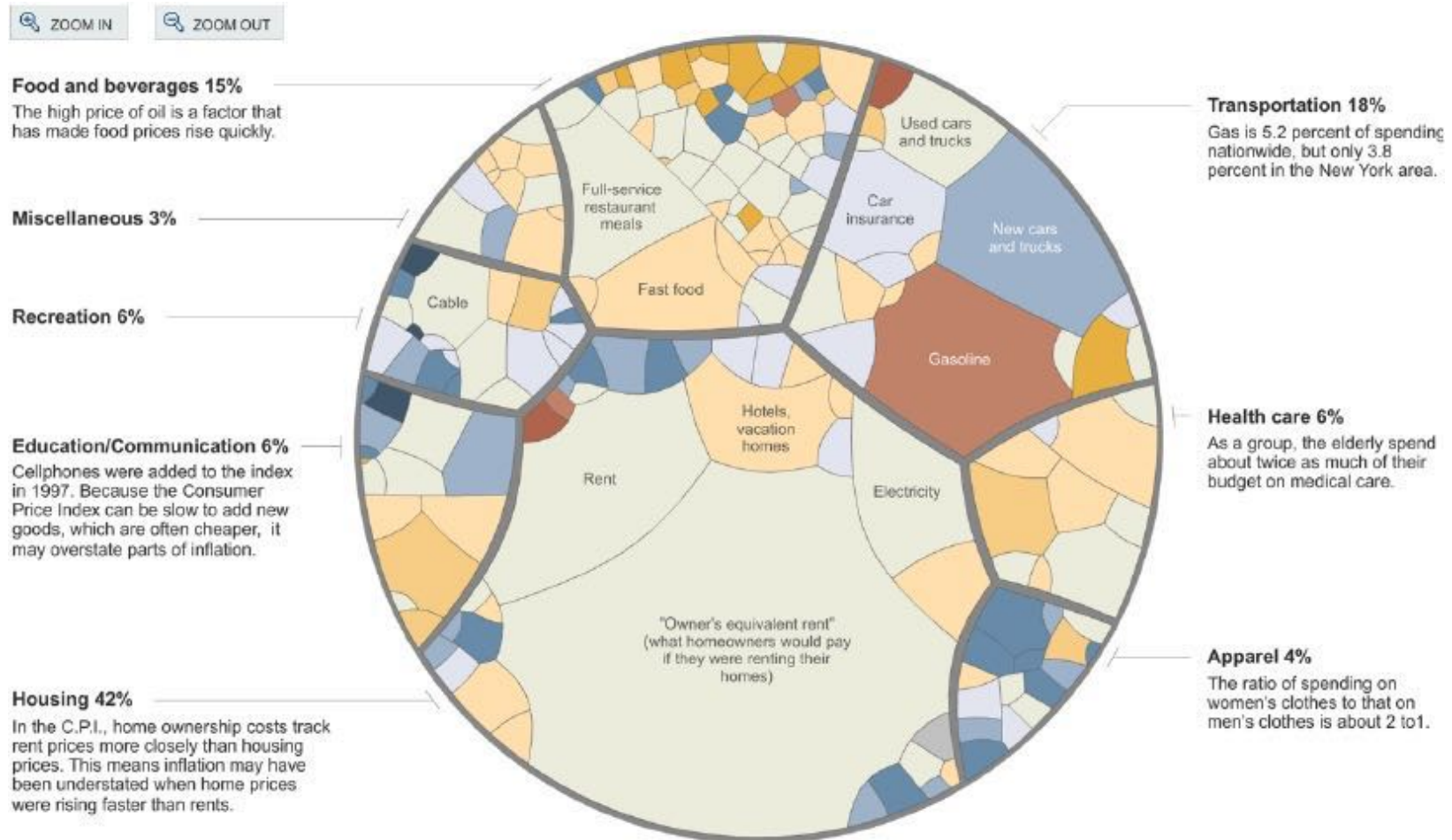
<http://graphics.uni-konstanz.de/~deussen/php/voronoitreemaps.php>

KEGG-Orthology Treemap



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

All of Inflation's Little Parts



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

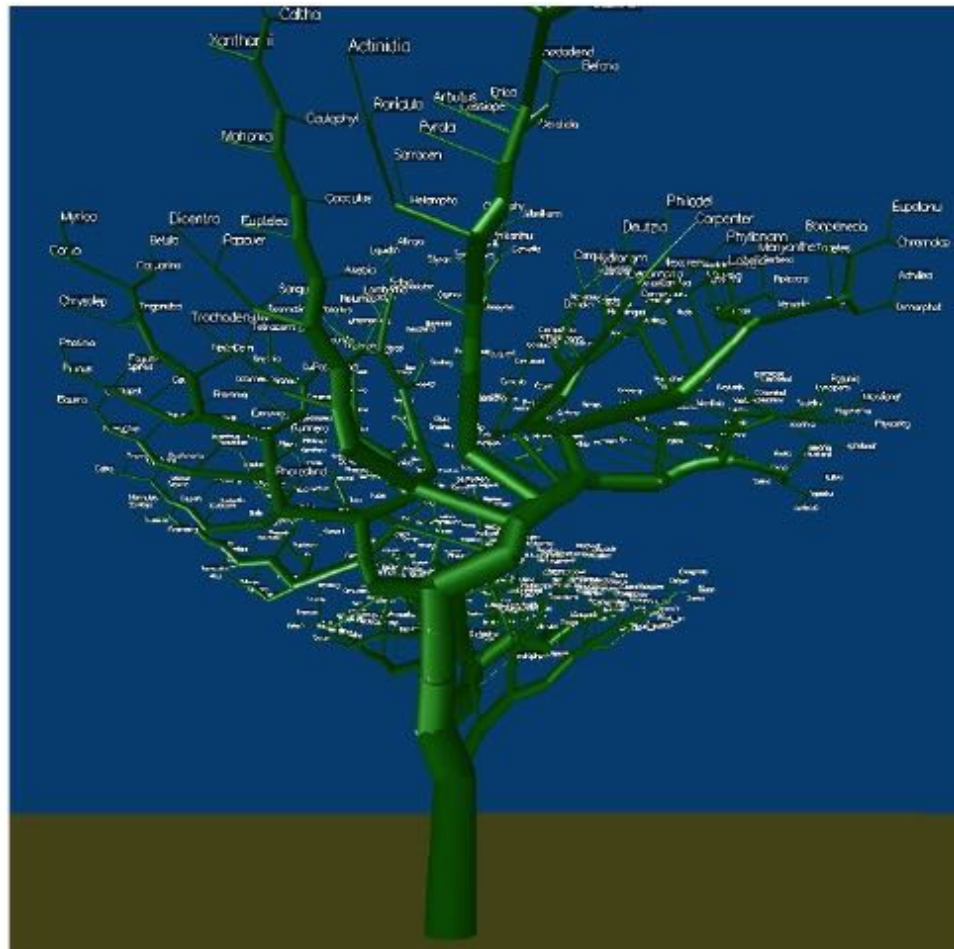
TREE OF LIFE

Case Study

Tree of Life

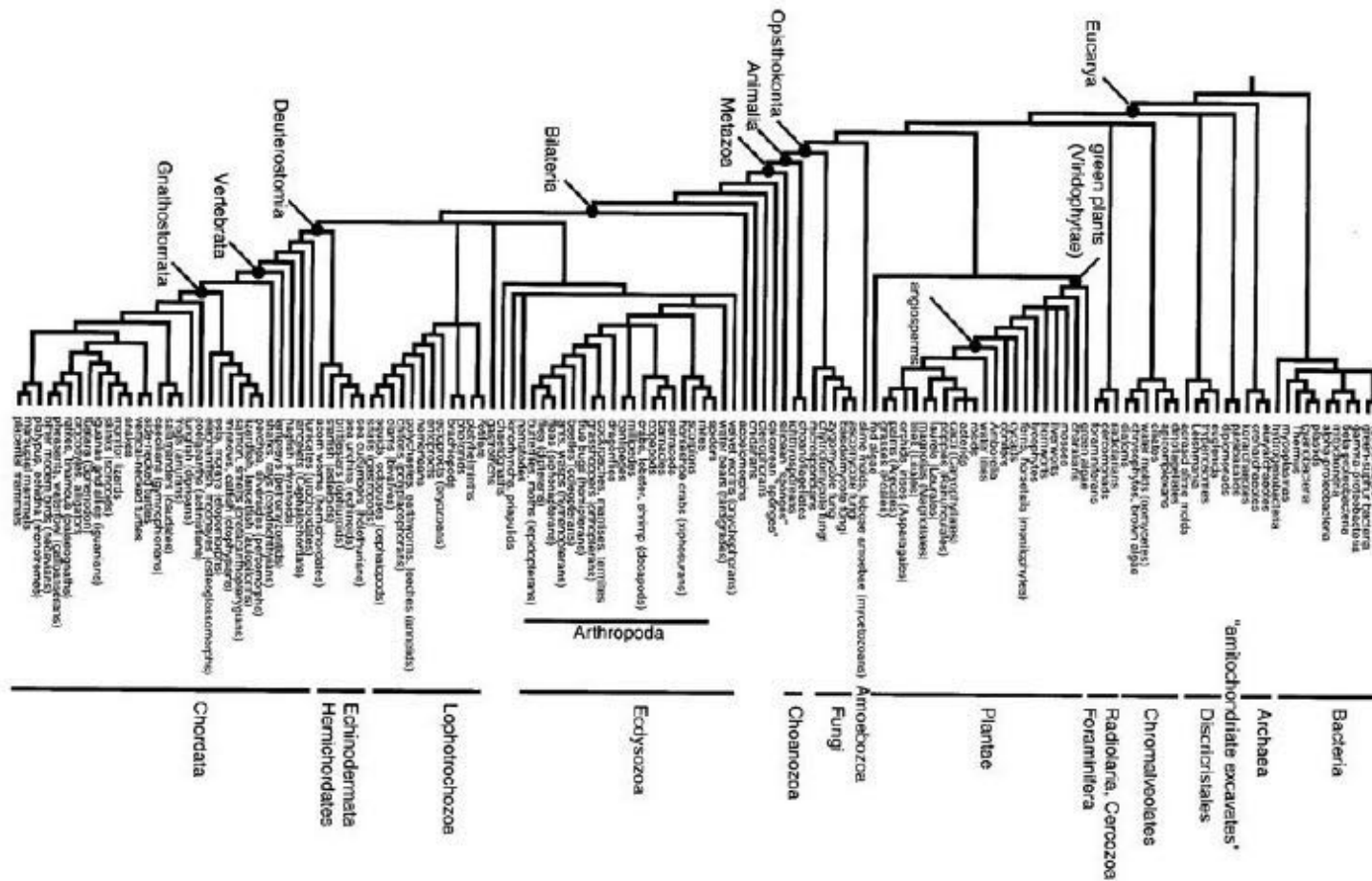
- Specifically phylogenetic tree of life
 - Evolutionary tree, showing where species branch
- Can be thousands to tens of thousands of nodes
- Many tools for the ToL exist using different visualization techniques
- See <http://tolweb.org/tree/phylogeny.html>

Paloverde



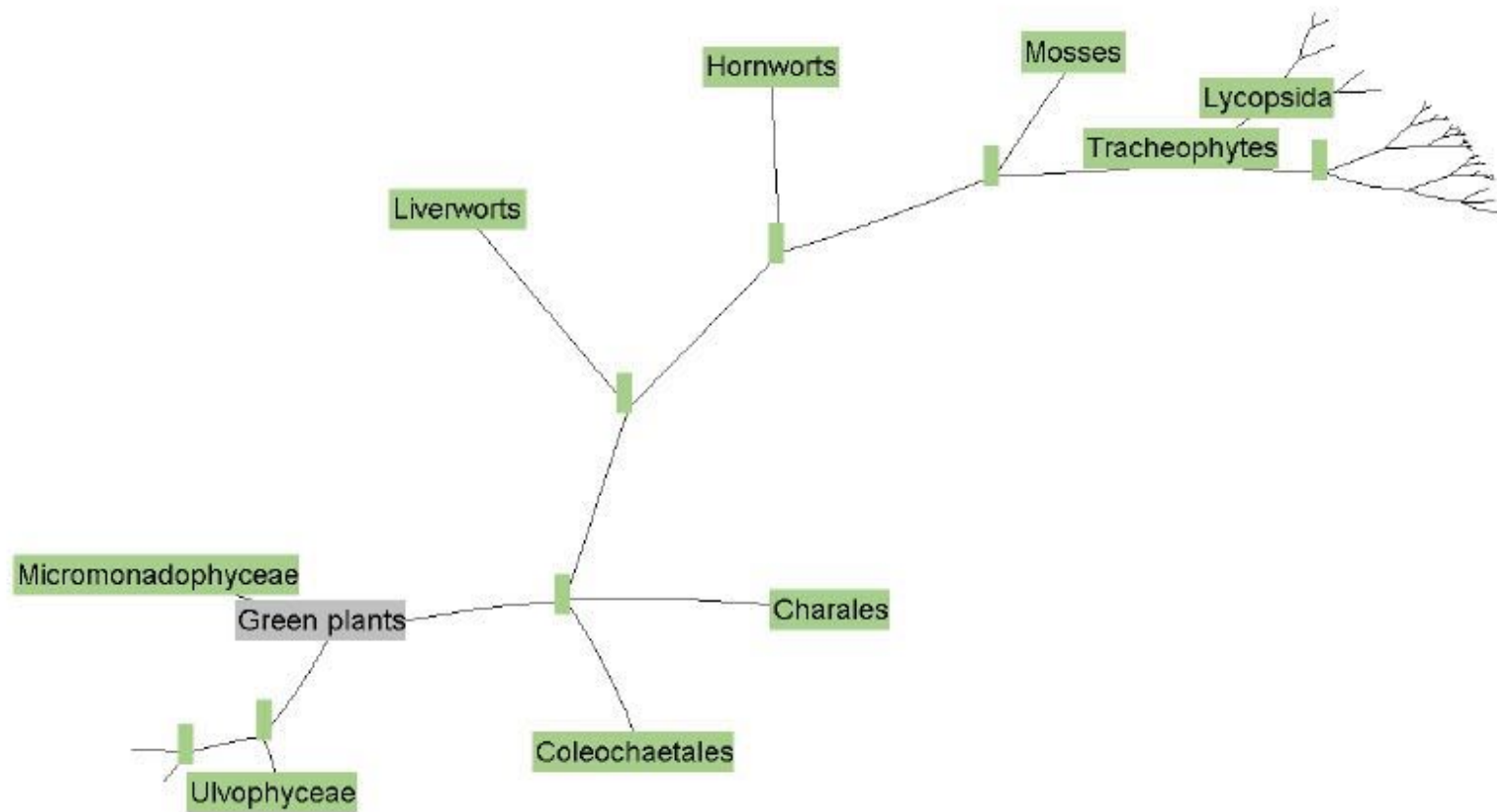
<http://loco.biosci.arizona.edu/paloverde/paloverde.html>

Teachable ToL



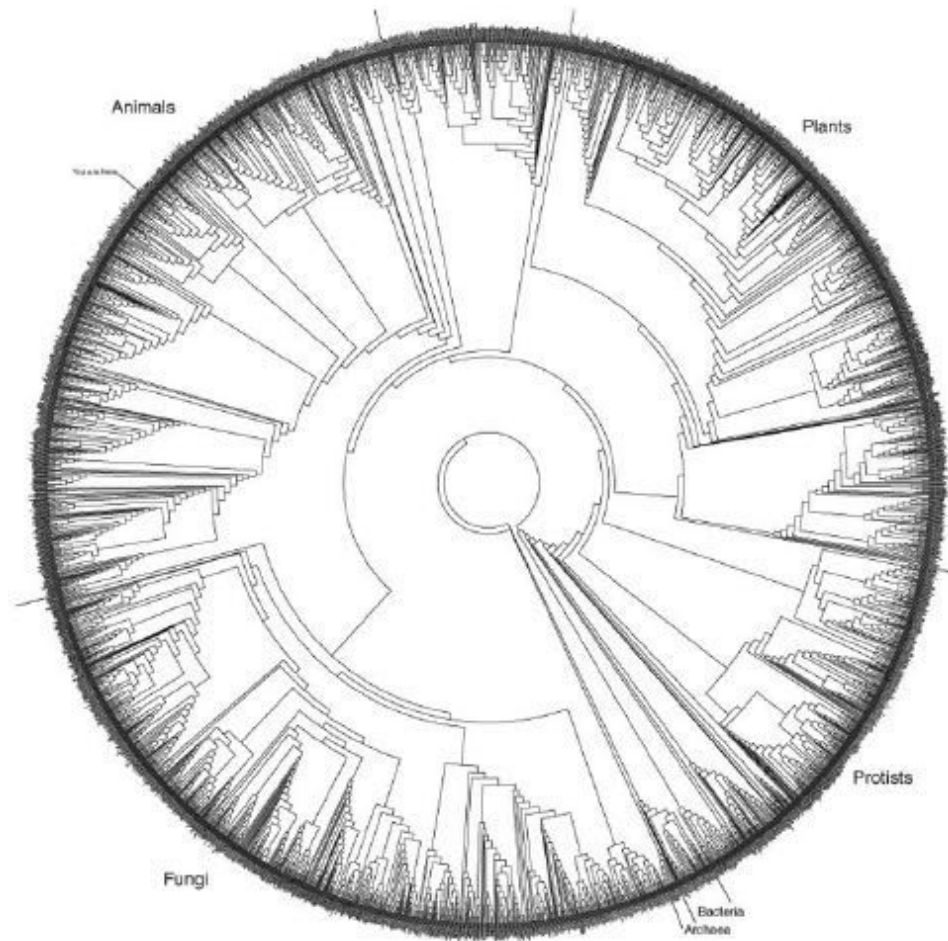
<http://www.rebeccashapley.com/cipres/telescoping.htm>

Hyperbolic ToL (Plants Only)

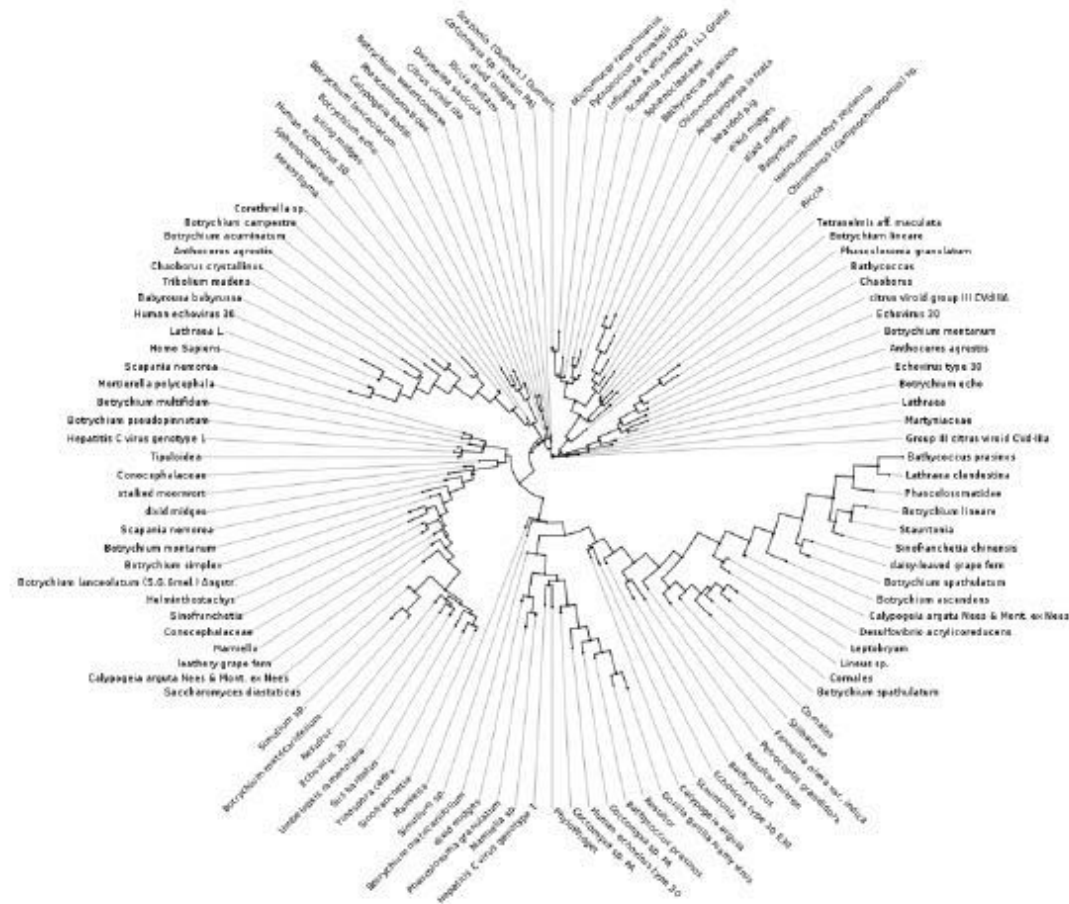


<http://ucjeps.berkeley.edu/TreeofLife/hyperbolic.php>

Subset of 3,000 Species



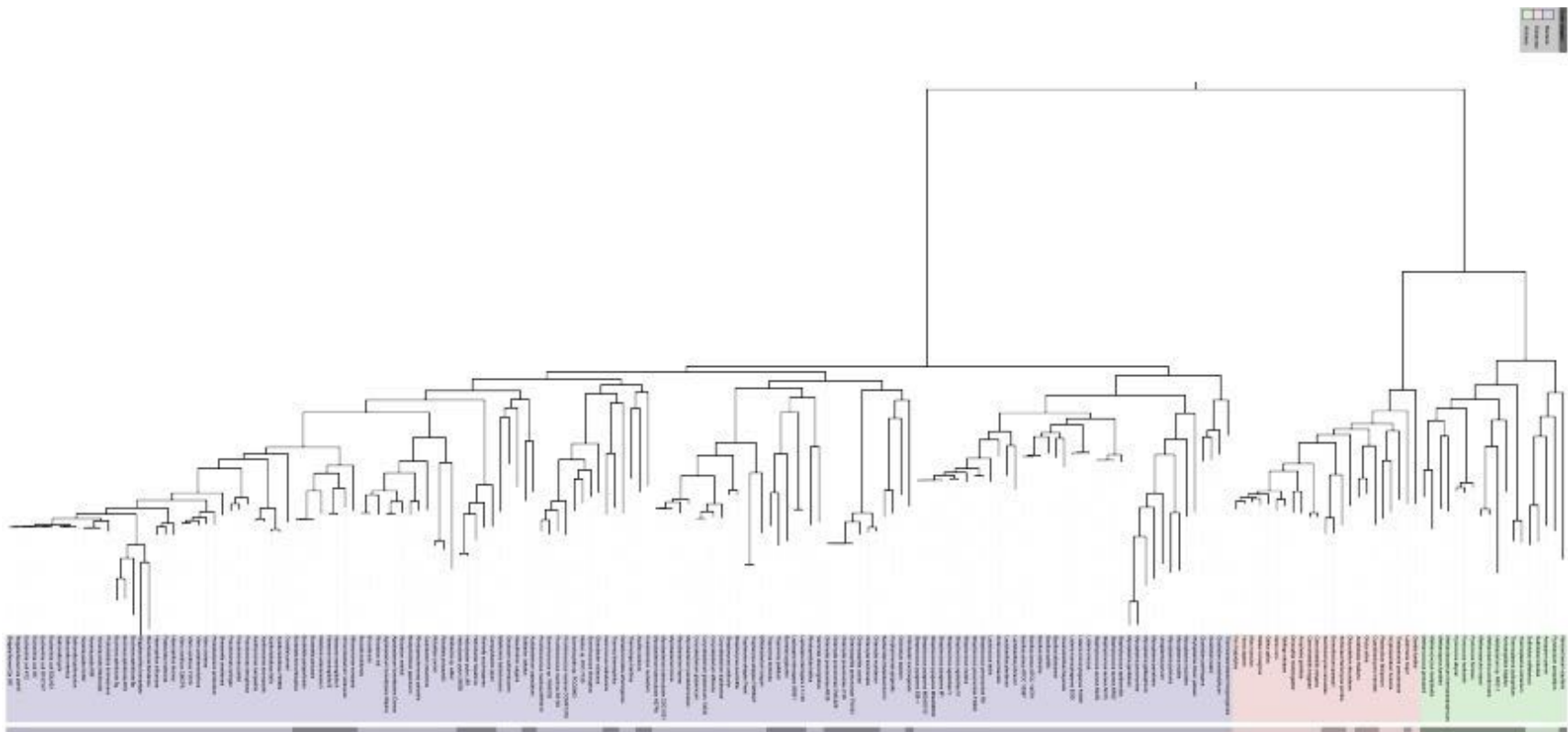
<http://www.zo.utexas.edu/faculty/antisense/DownloadfilesToL.html>



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

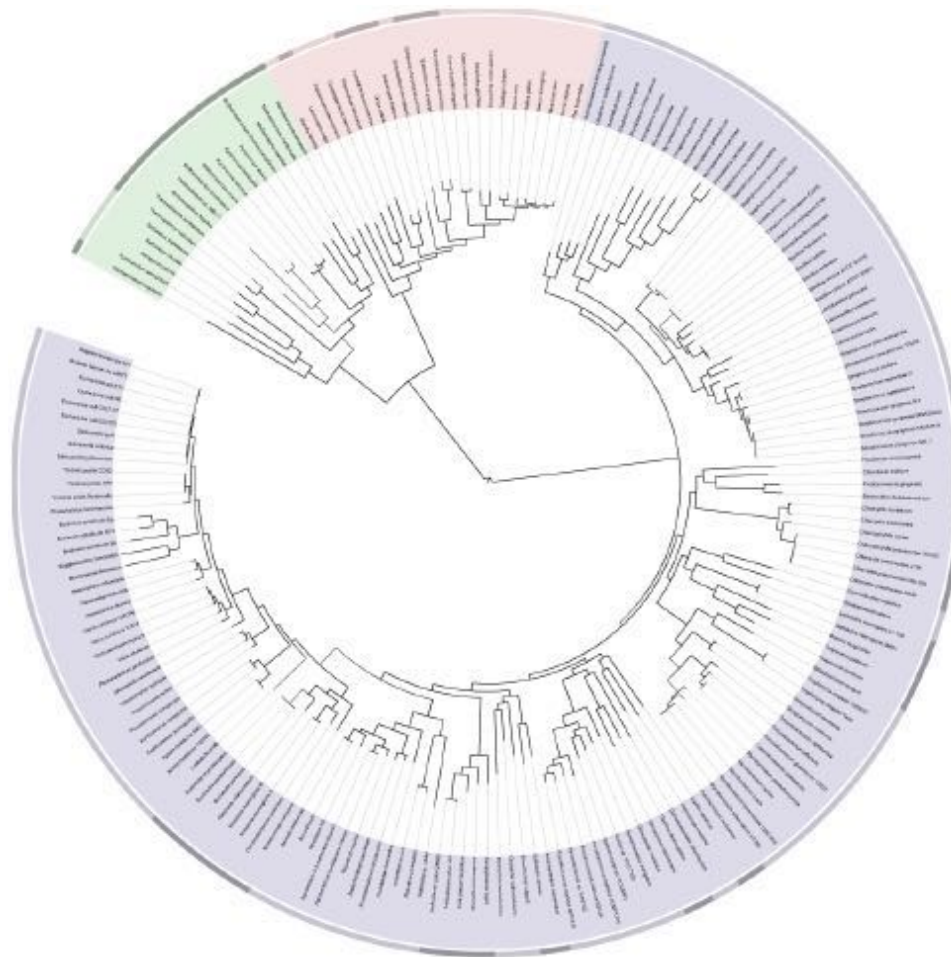
<http://www.phylowidget.org/>

Interactive ToL



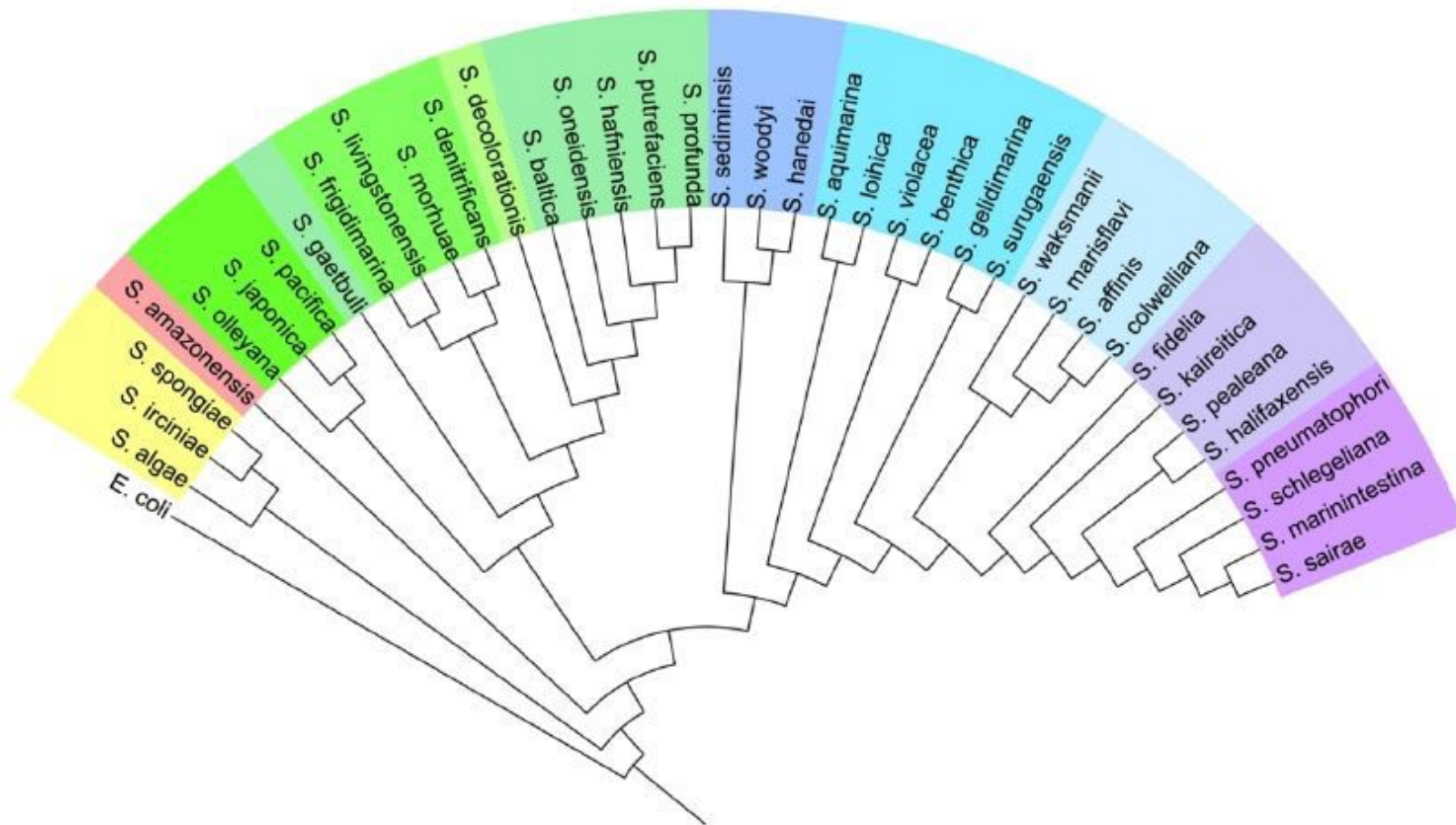
<http://itol.embl.de/>

Interactive ToL



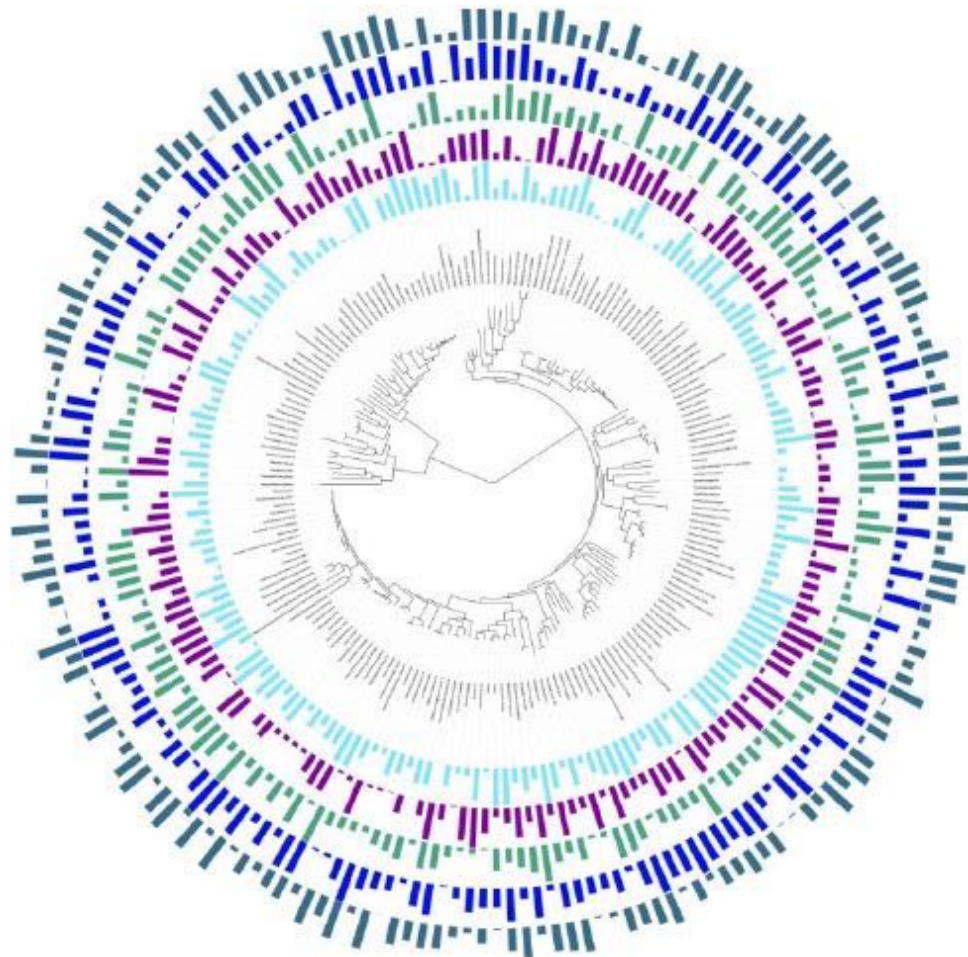
<http://itol.embl.de/>

Interactive ToL



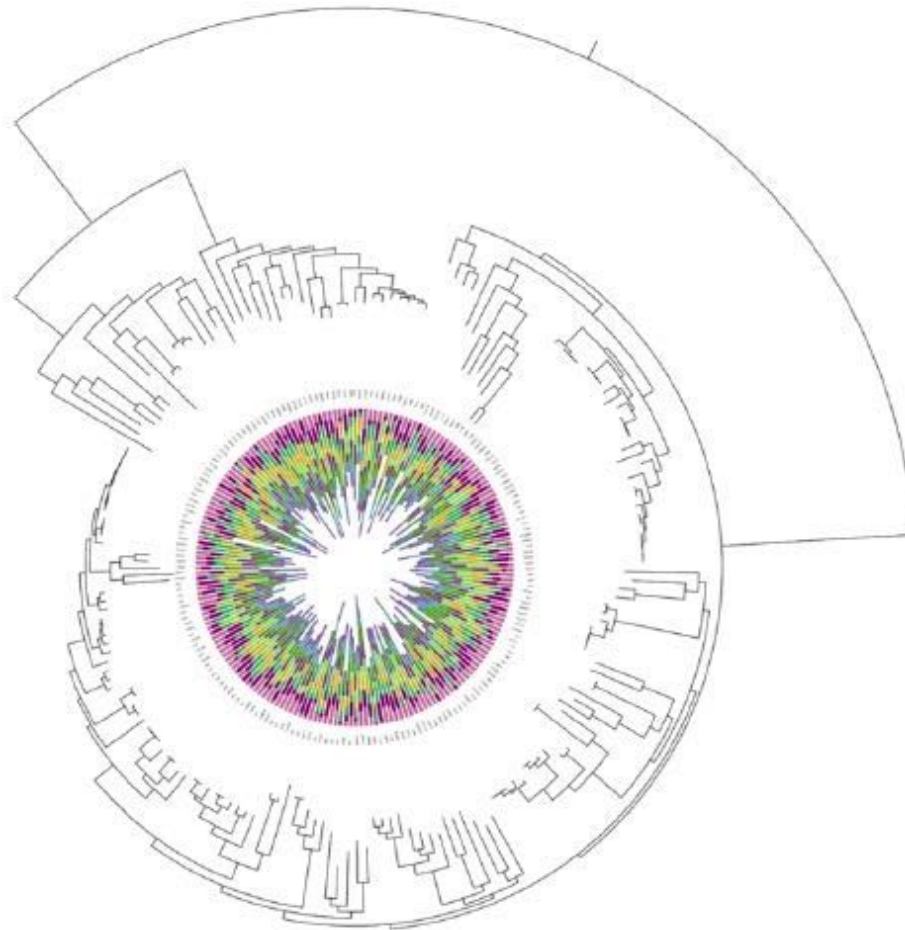
<http://itol.embl.de/>

Interactive ToL



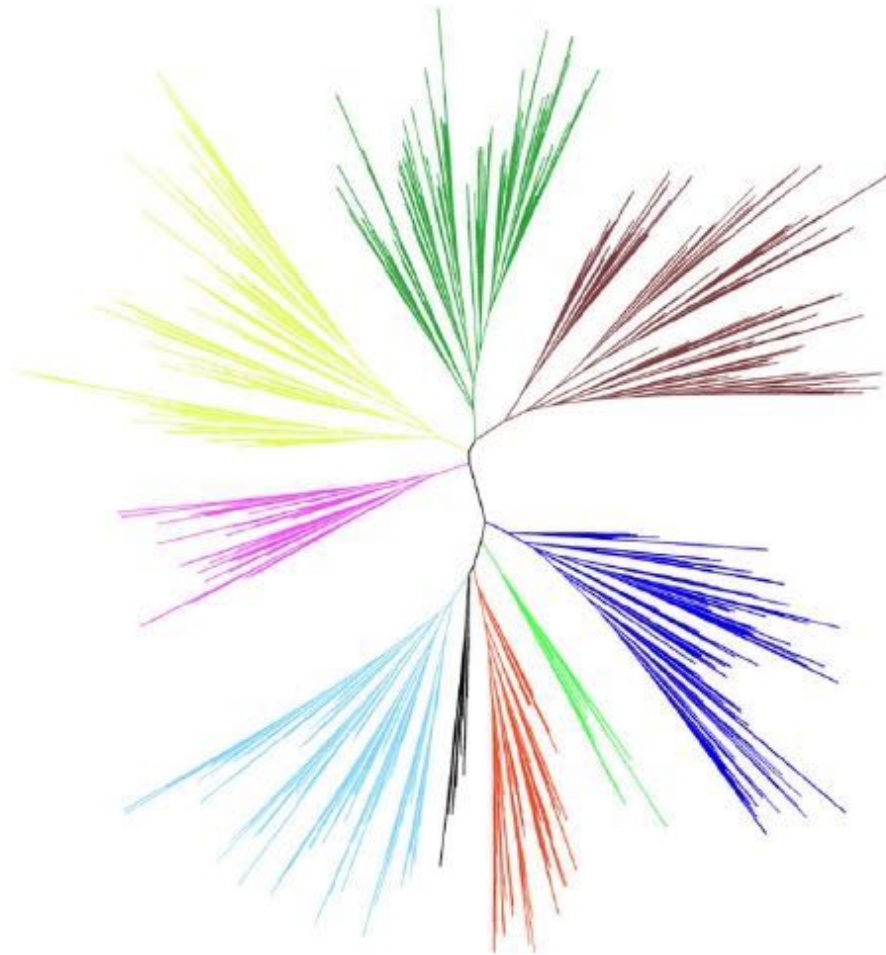
<http://itol.embl.de/>

Interactive ToL



<http://itol.embl.de/>

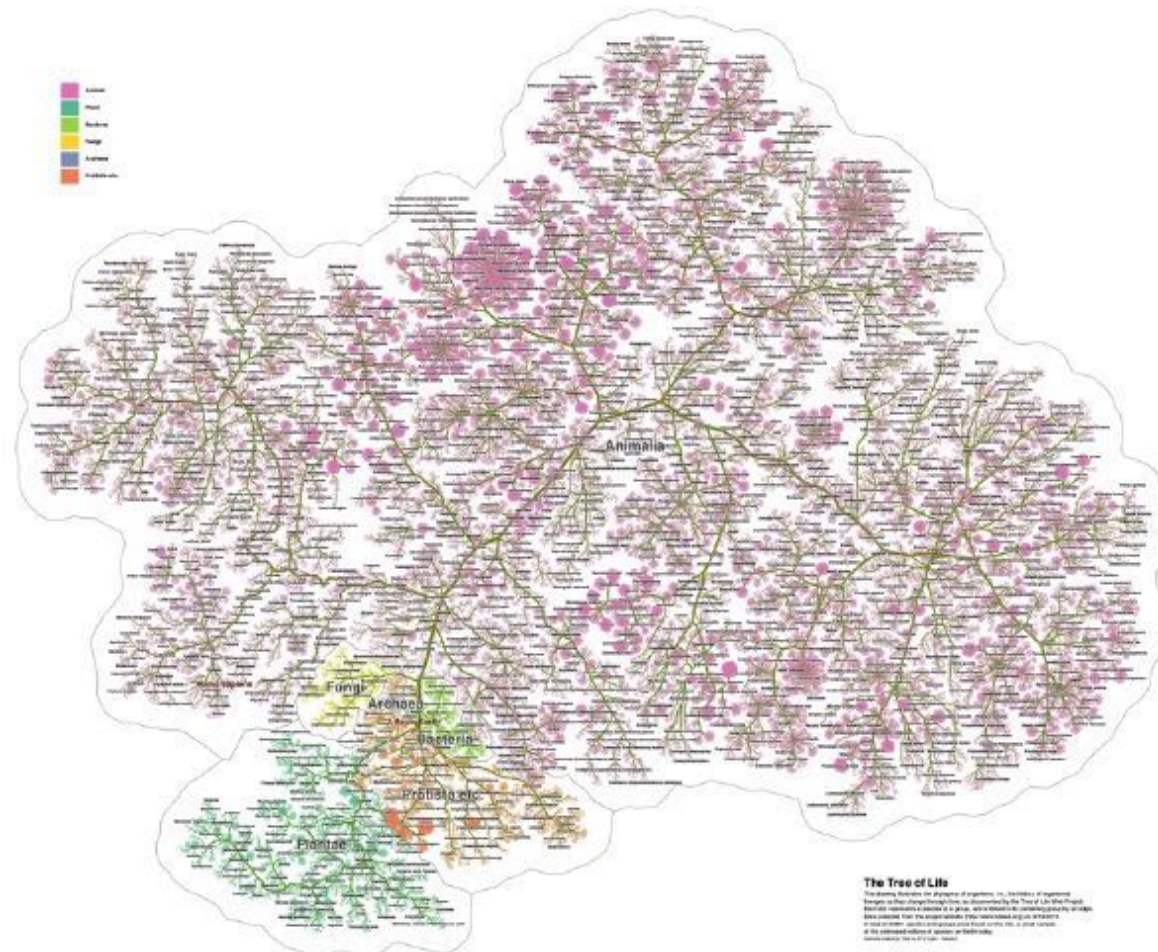
Interactive ToL



<http://itol.embl.de/>

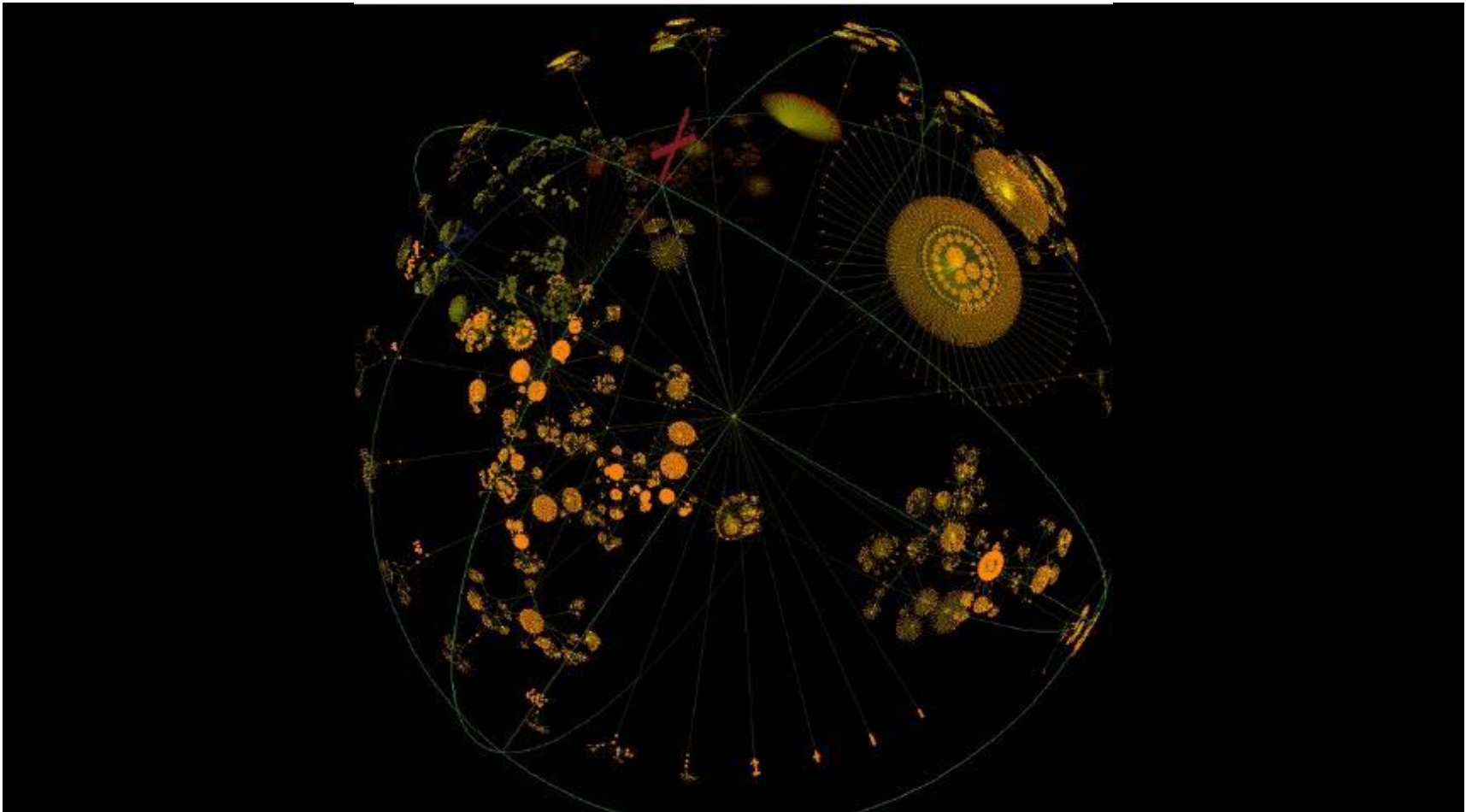


Interactive ToL (2)



<http://www2.research.att.com/~yifanhu/TOL/>

ToL Using Walrus



<http://digitised.info/content/view/20/51/>

QUESTIONS?



*Thanks to
Sophie J. Engle
San Francisco University
for ideas, suggestions, slides, links, and much other stuff*