

Hierarchical Data Visualization

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Admin stuff Reminder

- Project prototype due May 1st
 - At least $\frac{1}{2}$ of your final project
 - You will receive feedback in class on May 3rd
- Prototype day May 3rd
 - Divide the class on groups of 6 or so (different classrooms)
 - Each person will get 15 minutes to present
 - Everyone else will give oral and written feedback
 - Random assignments to groups
 - **Please, please try as much as you can to attend this class**
 - I am not sure how to grade you otherwise

Agenda

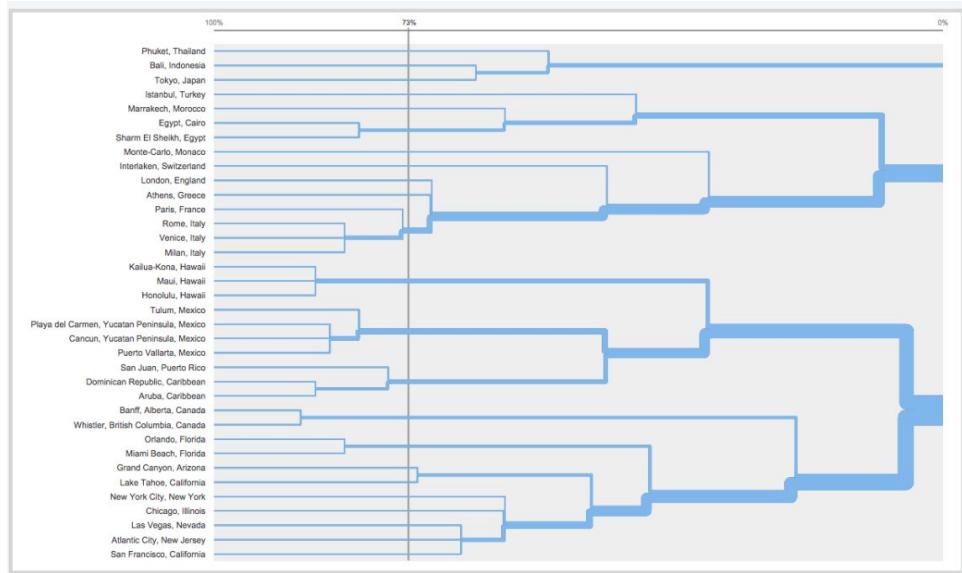
- Hierarchical Data
- Trees
- Tree Visualization Techniques
- Adding html to shiny
- Lab-4 (Treemap)

Hierarchical data

- Any data with some sort of hierarchy
 - "Group of objects ranked so that every one but the topmost is subordinate to one above it."
- Example hierarchy
 - Country: United States
 - Region: West
 - State: California
 - County: San Francisco County
 - City: San Francisco

Examples of Hierarchical Data

- Evolutionary Tree
- Dendograms
- File Directory Structure
- Family History
- Organization Charts
- Outlines



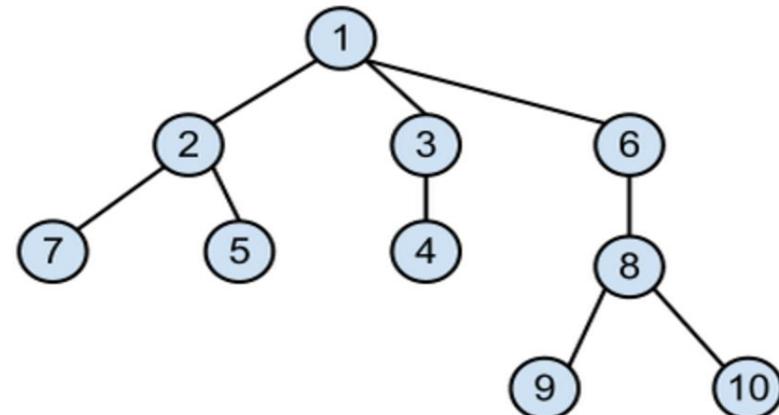
Output of a hierarchical clustering algorithm

Tree Structures

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

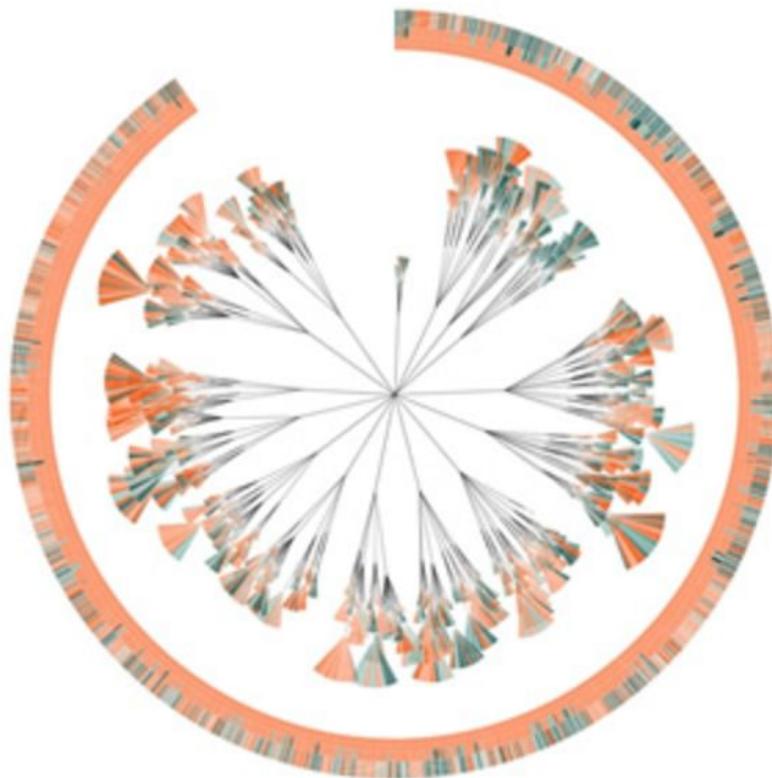
Hierarchical Data Representation: Tree

- Tree $G = (V, E)$
 - V set of nodes
 - E set of edges
 - Edges $e = (v, u)$ where u and v are nodes
 - Each node has a unique label
 - 1 is the root of the tree
 - 7, 5, 4, 9, 10 are leaf nodes



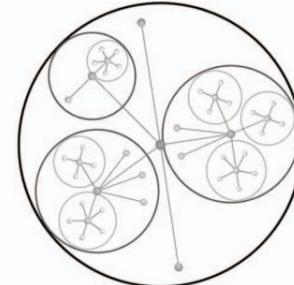
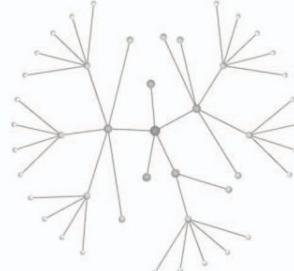
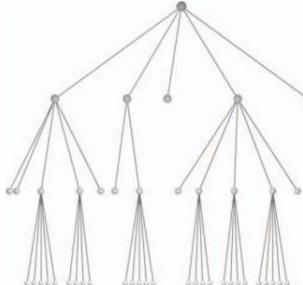
The Origin of Species

- Chapters are divided into subchapters as in Darwin's original text, and these sub-chapters are divided into paragraph 'leaves'.
- The small wedge-shaped 'leaflets' represent sentences.
- Each sentence is coloured according to whether the sentence will survive to the next edition (**blue**) or whether it will be deleted and not be within the next edition (**orange**).

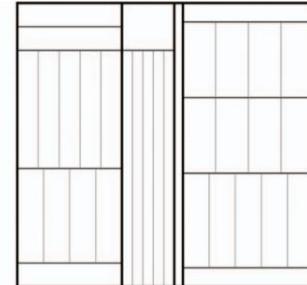


Tree Visualization Techniques

- Node-Link Diagrams
 - Traditional node-link diagram
 - Dendograms
 - Hyperbolic trees
 - Balloon tree



- 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?

NODE-LINK DIAGRAMS

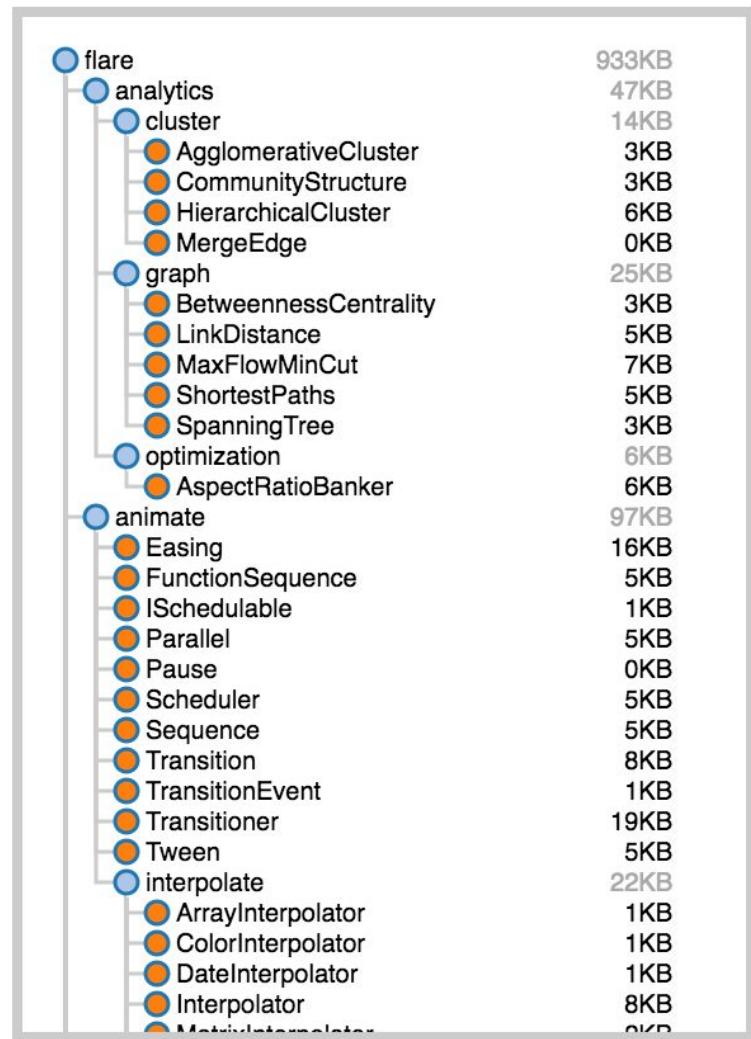
Tree Visualization

Node-Link Diagrams: indent layout

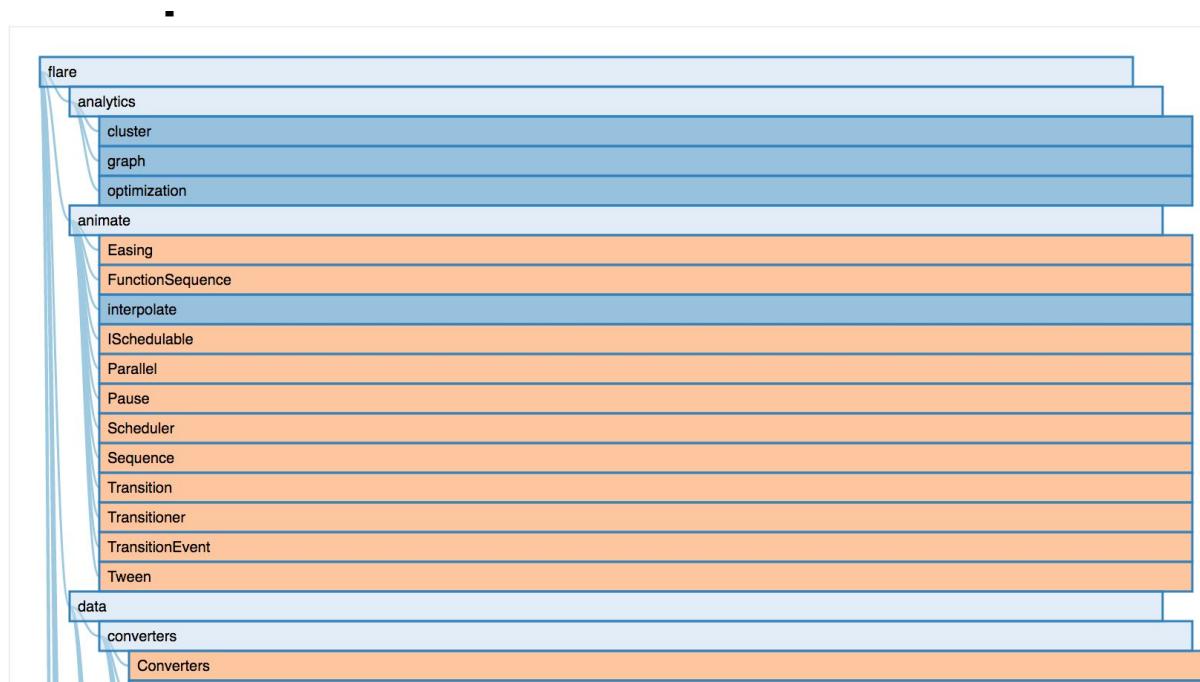
- Places all items along vertically spaced rows
- Indentation used to show parent/child relationships
- Commonly used as a component in an interface
- Breadth and depth contend for space
- Often requires a great deal of scrolling

DEMO

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



Node-Link Diagrams: indent layout

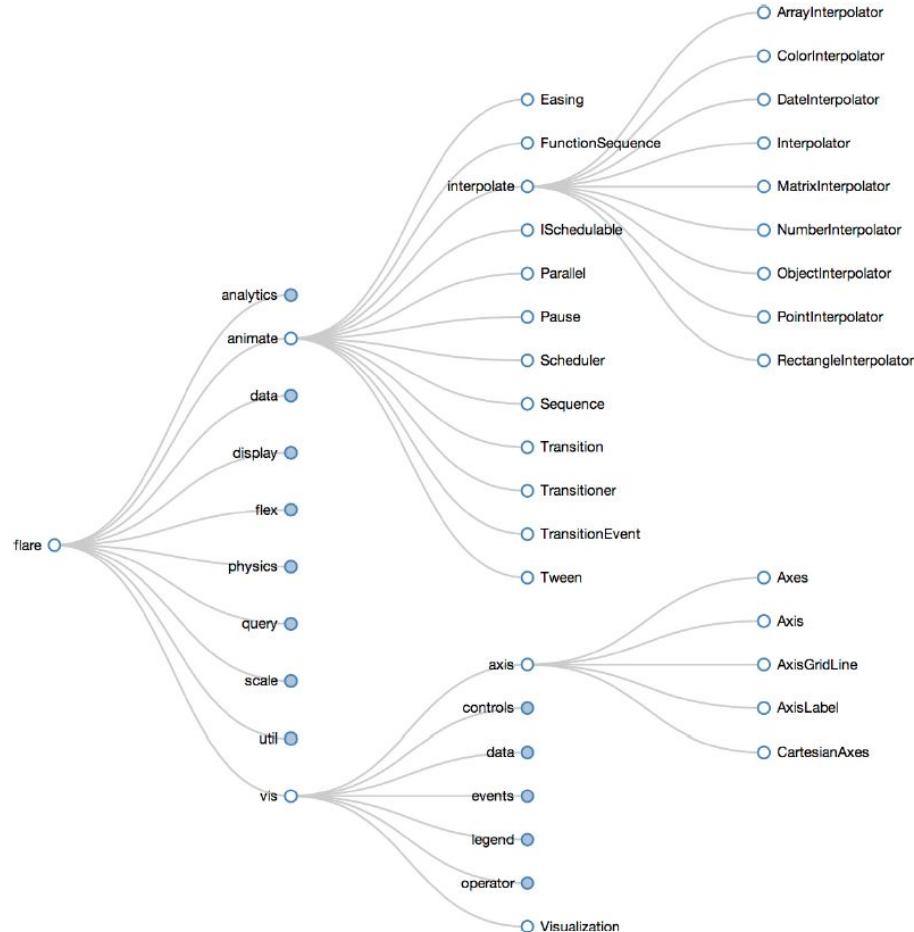


<https://bl.ocks.org/mbostock/1093025>

Node-Link Diagrams: Traditional Layout

- 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)

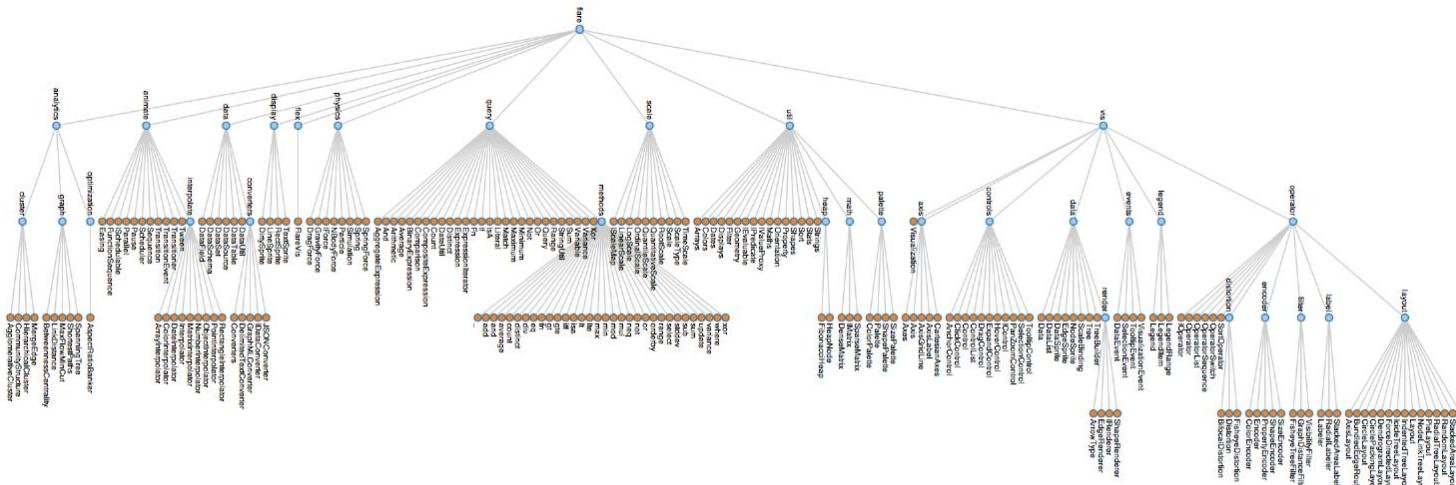
Traditional Layout



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

DEMO

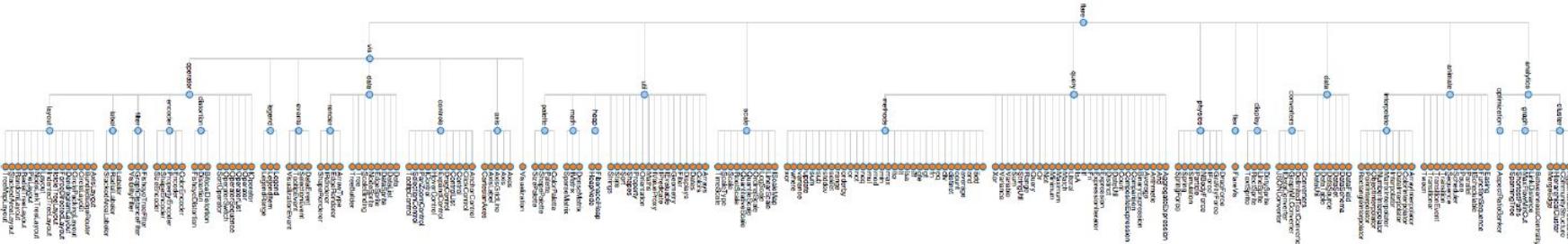
Traditional Layout



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

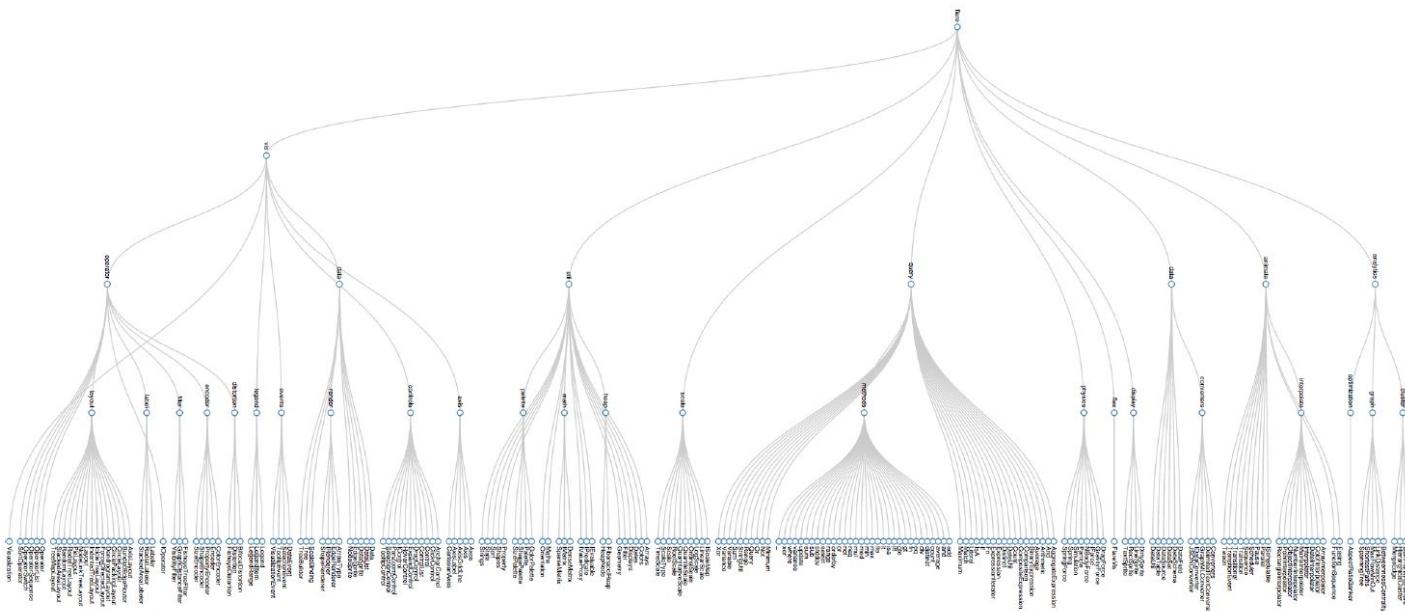
Source: Flare Visualization Toolkit

Dendrogram



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

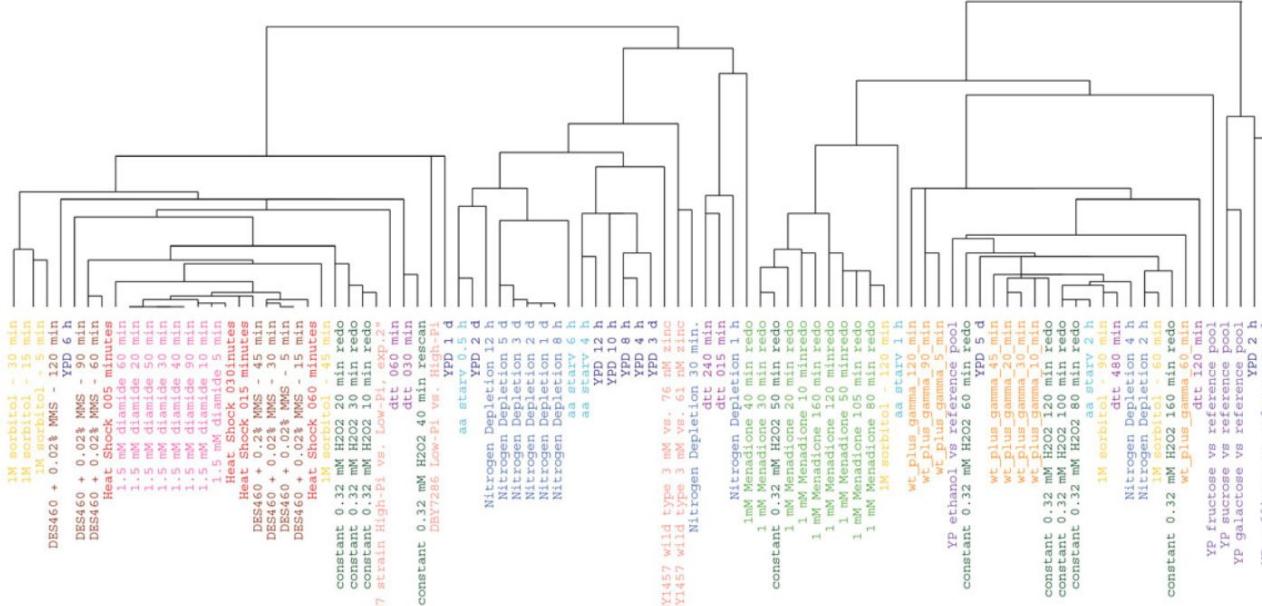
Dendrogram



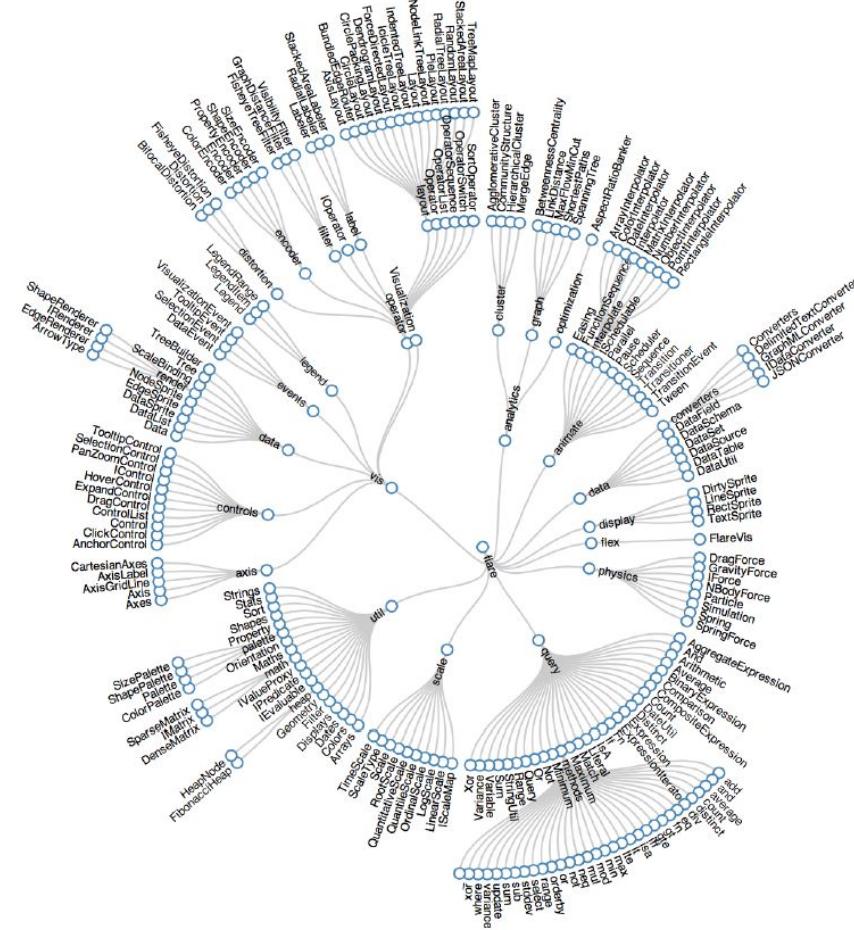
<http://mbostock.github.io/protovis/ex/dendrogram.html>

Dendrogram

Cluster 11: protein folding chaperones



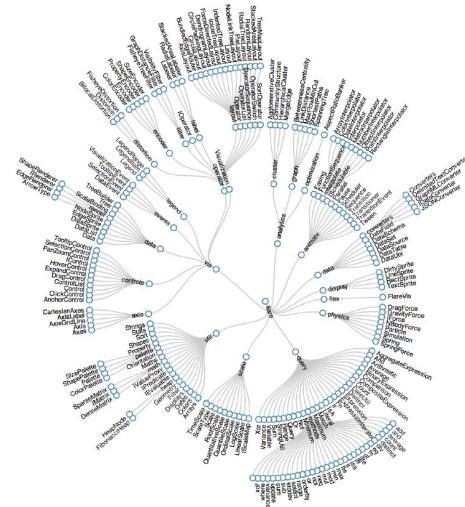
Circular Layout



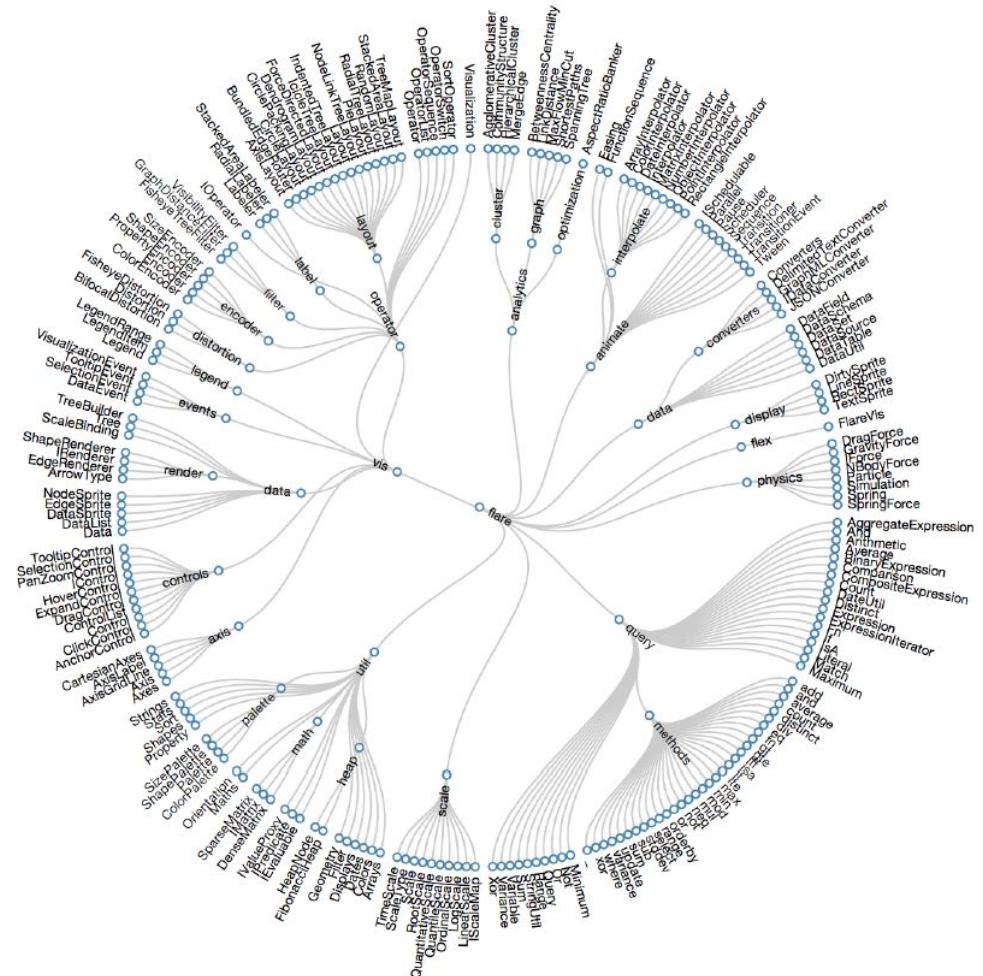
<http://bl.ocks.org/mbostock/4063550>

Circular Layout

- Root at the center
- Nodes of different levels are placed on circles of different radii
- More effective use of space: more nodes at deeper levels (hence more space)

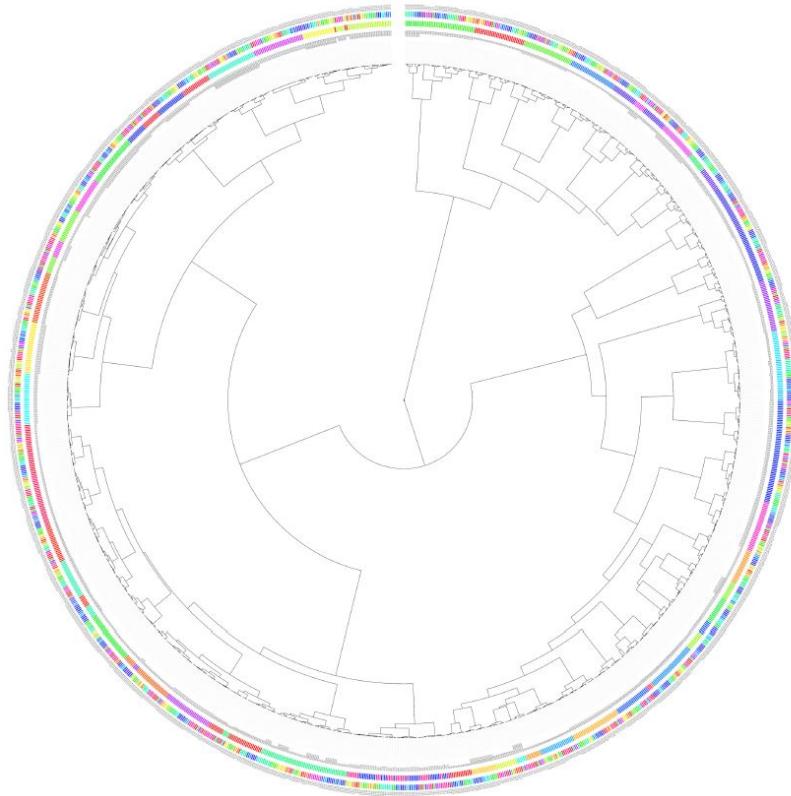


Circular Dendrogram



<http://mbostock.github.io/d3/talk/201110/>

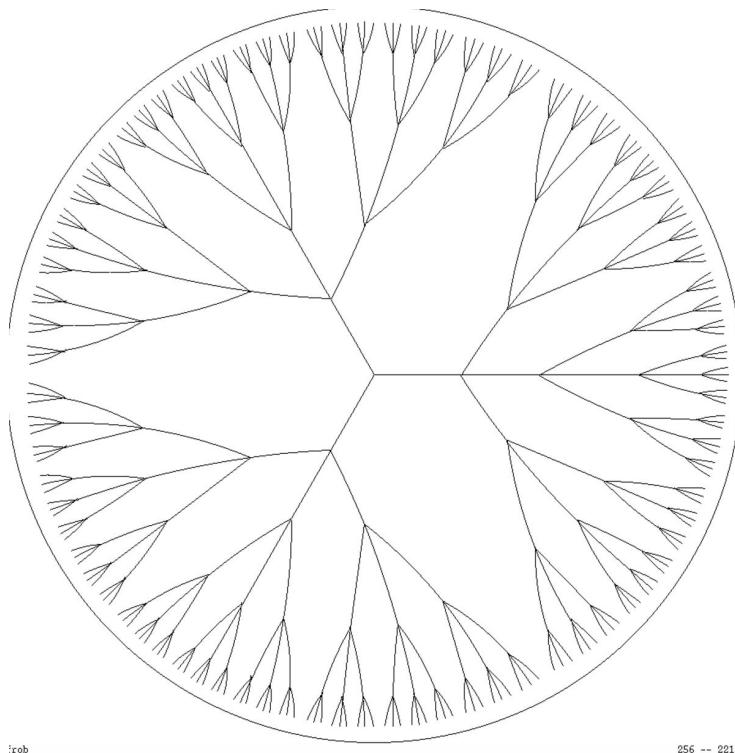
Circular Dendrogram



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

Layout: Hyperbolic Tree

- Perform tree layout in hyperbolic geometry, then project the result on to the Euclidean plane.
- The hyperbolic plane expands exponentially!



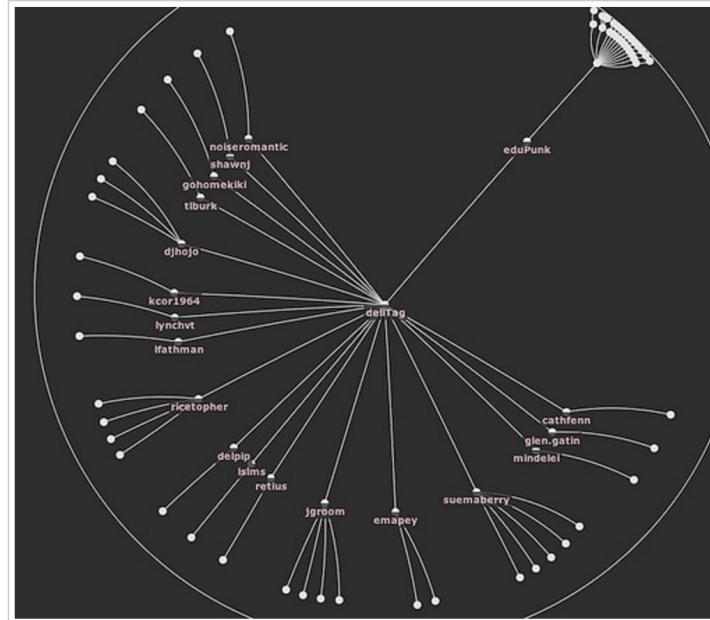
:rob

256 -- 2218

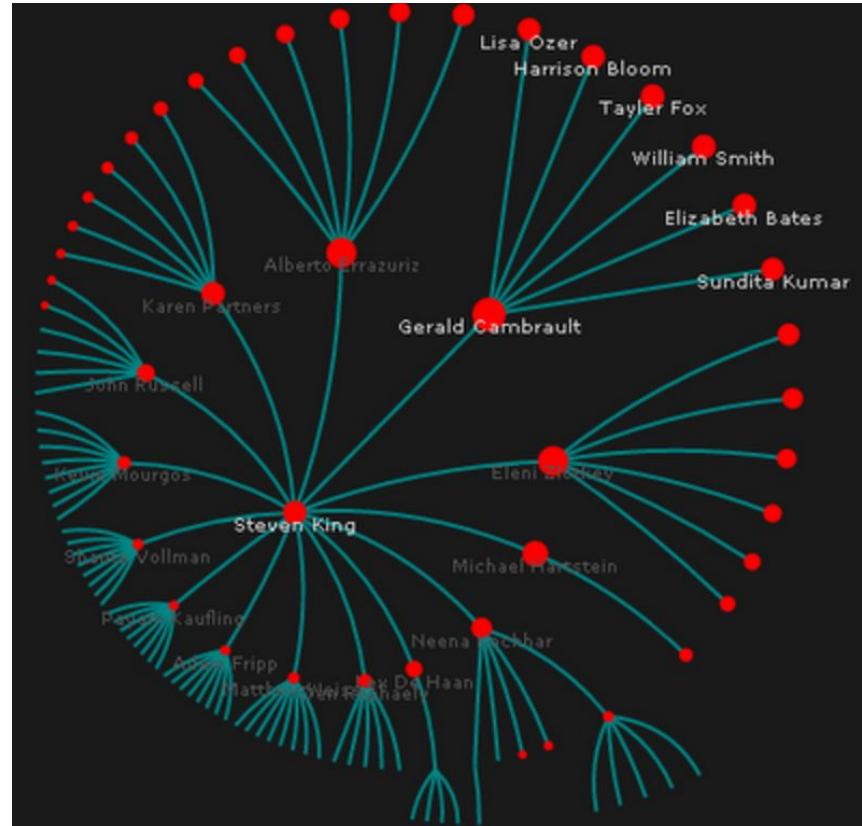
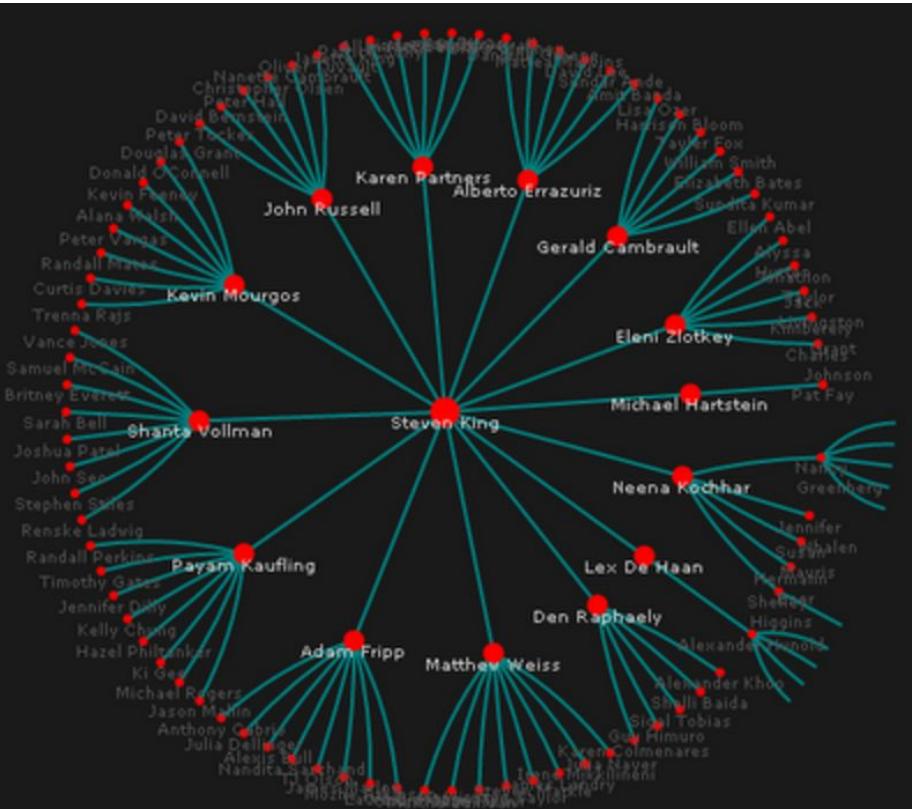
A uniform tree of depth 5 and branching factor 3 (364 nodes).

Hyperbolic Tree

- Dynamic way of recentering the view with the node of the tree you are interested in at the centre of the diagram.
- In this example, 'edupunk' is the actual root of the tree, and 'delitag' is one of its two child nodes, that is currently the focus of attention.

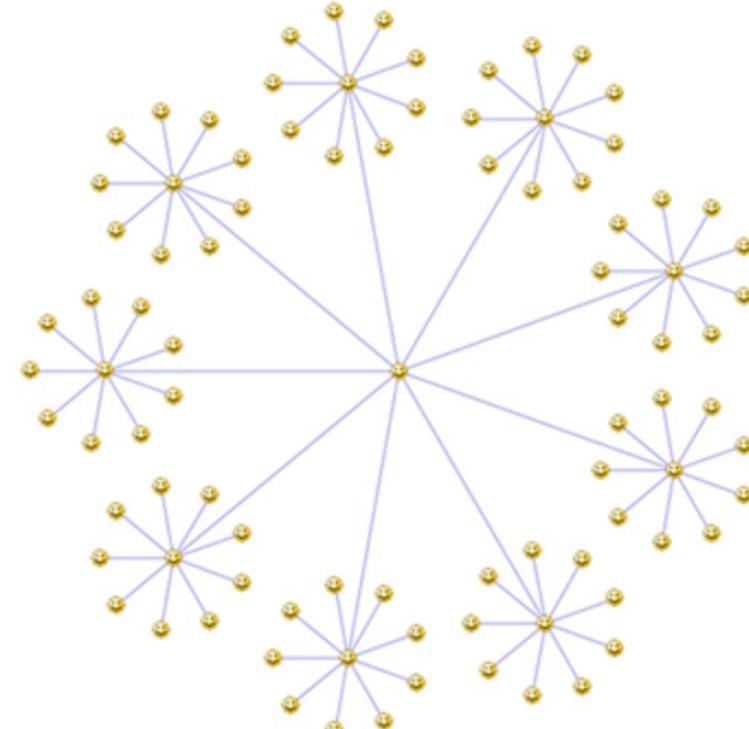


Hyperbolic Tree



Layout: Balloon Tree

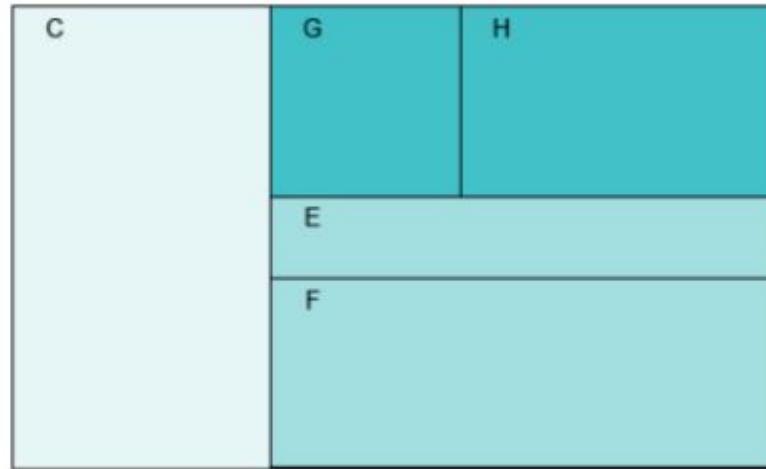
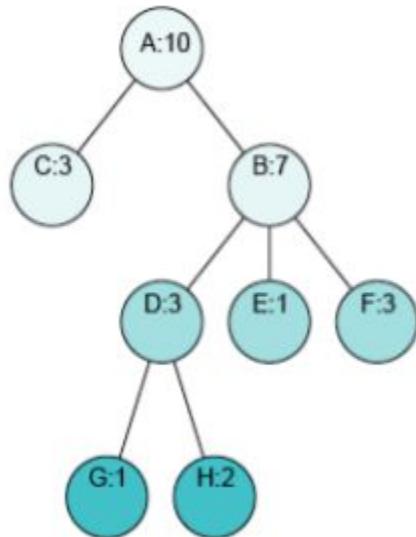
Places the subtrees of a node in circles, which are themselves placed on the circumference on a big circle around the node.



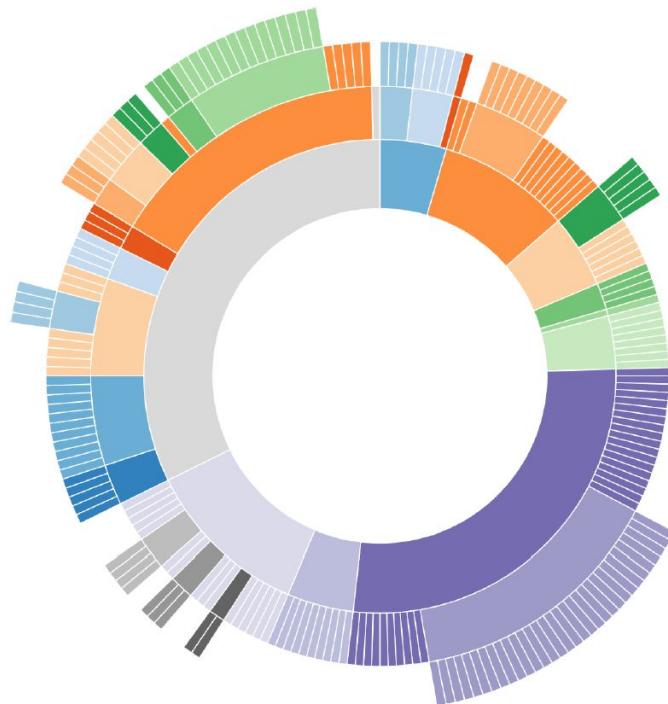
SPACE-FILLING DIAGRAMS

Tree Visualization

SPACE-FILLING techniques



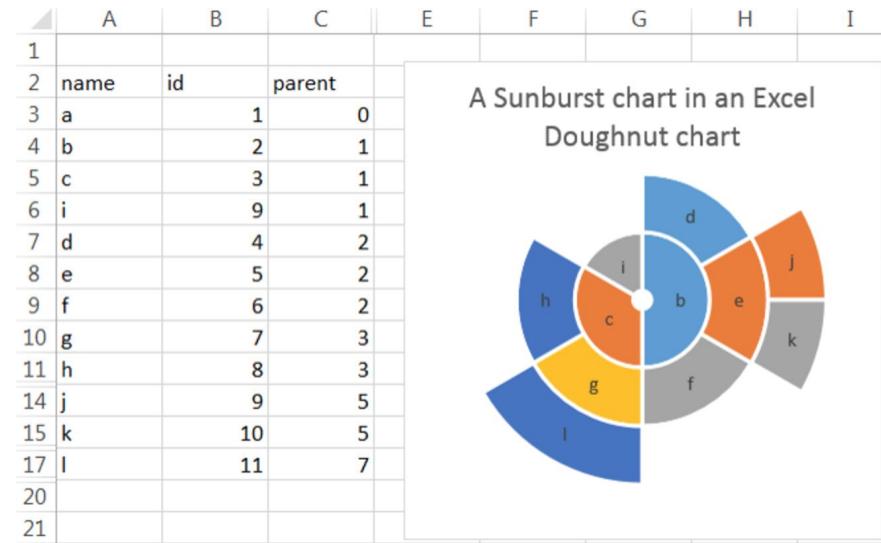
Sunburst Diagram



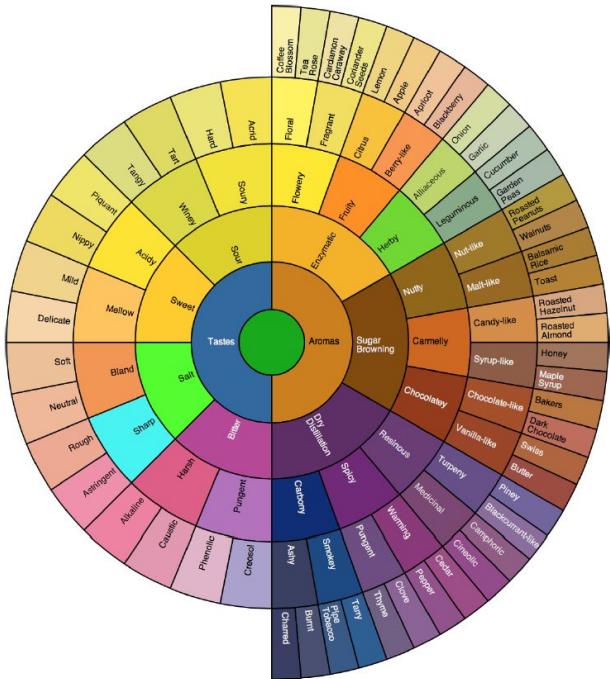
<http://bl.ocks.org/mbostock/4063423>

Sunburst Diagram

- Adjacency diagram: a space-filling variant of the node-link diagram
- Nodes are drawn as solid areas
- Placement relative to adjacent nodes reveals their position in the hierarchy
- We can use the angle and color to encode additional dimension
- Higher-level nodes get a larger layer area

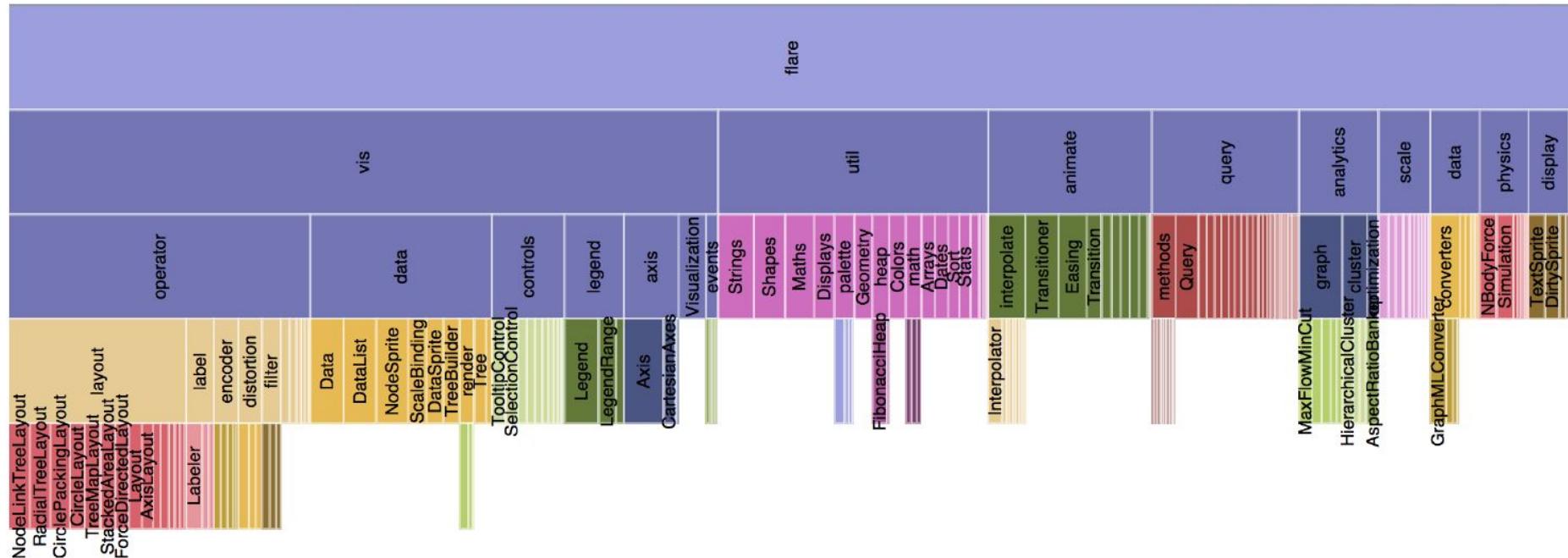


Sunburst Diagram



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

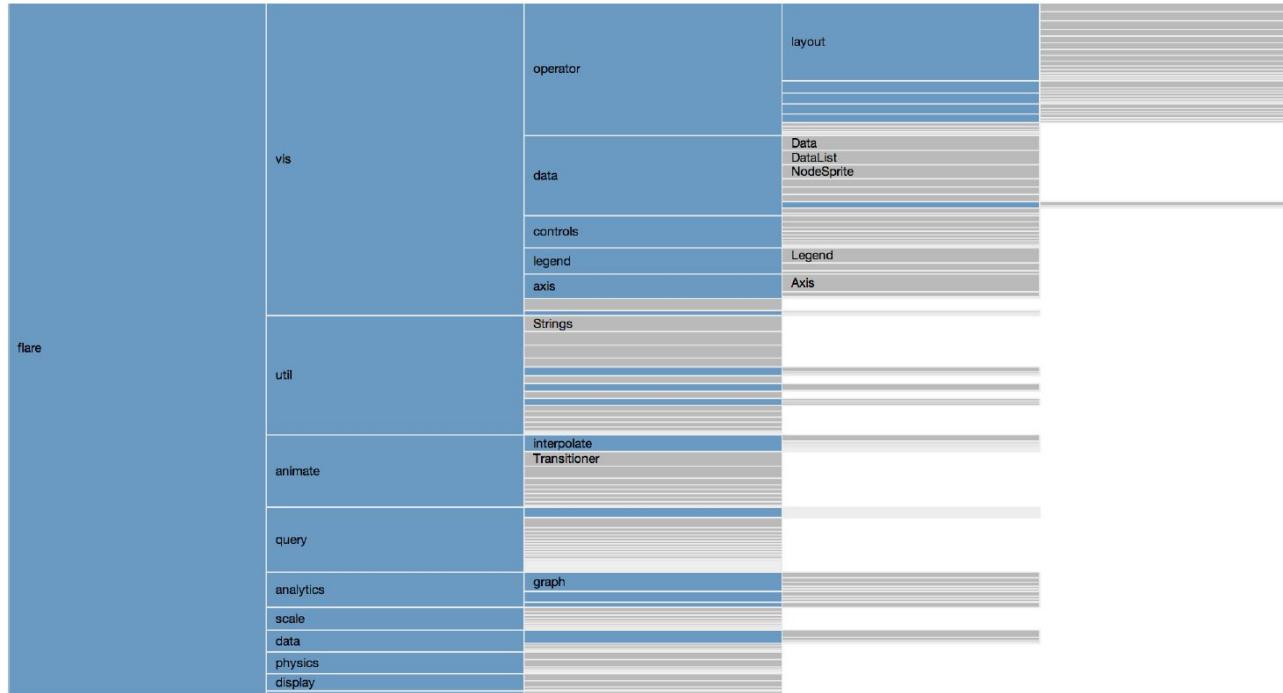
Icicle Diagram



sunburst transformed from polar to cartesian coordinates.

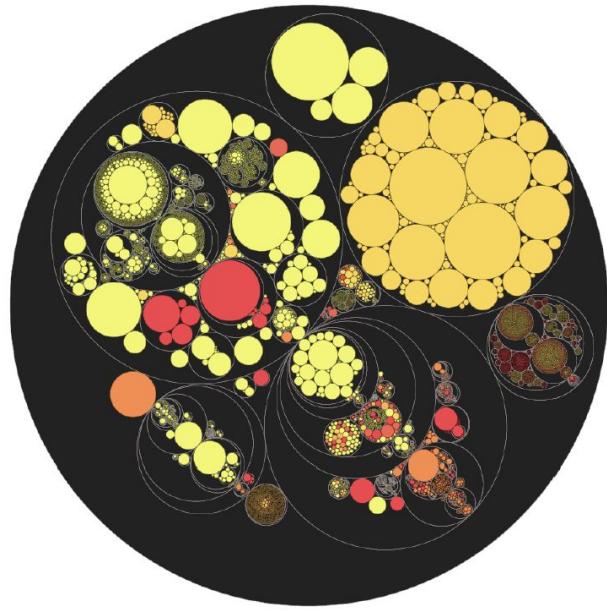
<http://mbostock.github.io/protovis/ex/icicle.html>

Icicle Diagram

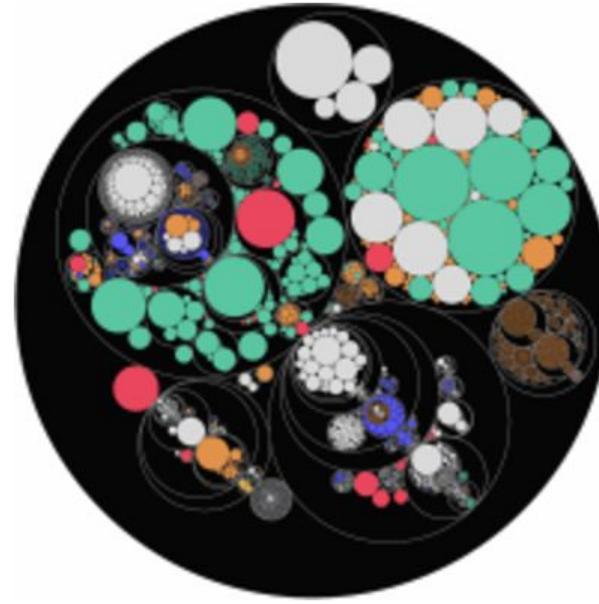


<http://mbostock.github.io/d3/talk/20111018/partition.html>

pebbles - using Circular Treemaps to visualize disk usage



Colorize by **age** (modification time) or
time of last access

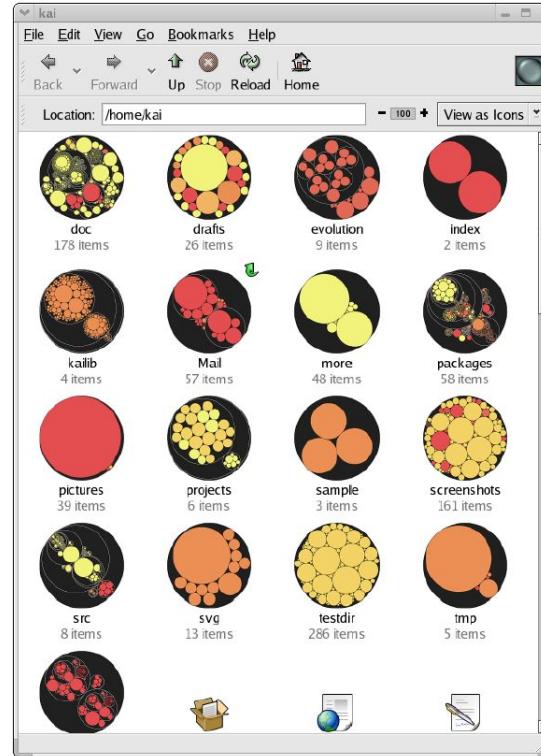


Colorize by **file type**

pebbles - using Circular Treemaps to visualize disk usage

Colorize by age (modification time) or time of last access

Red circles represent newer files while soft yellow circles represent older files.



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
- Encode structure using spatial enclosure
- Benefits
 - Provides a single view of an entire tree
 - Easier to spot large/small nodes
- Problems
 - Difficult to accurately read depth

Map of the Market

Goal: quick answer to "what's happening in the market?

Size = market capitalization

Color = percent change of the stock since the previous market close



Map of the Market: new treemap design

- Algorithm that produces a layout in which the vast majority of rectangles have reasonable aspect ratios
- Places companies with similar price histories near each other.

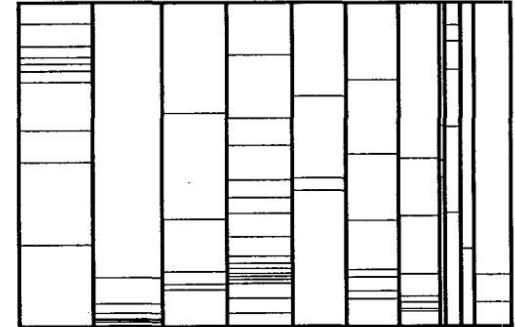


Figure 1: Typical slice-and-dice layout

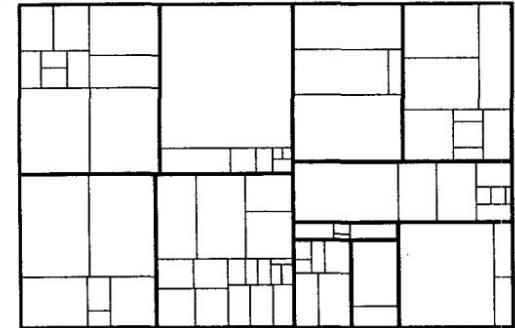
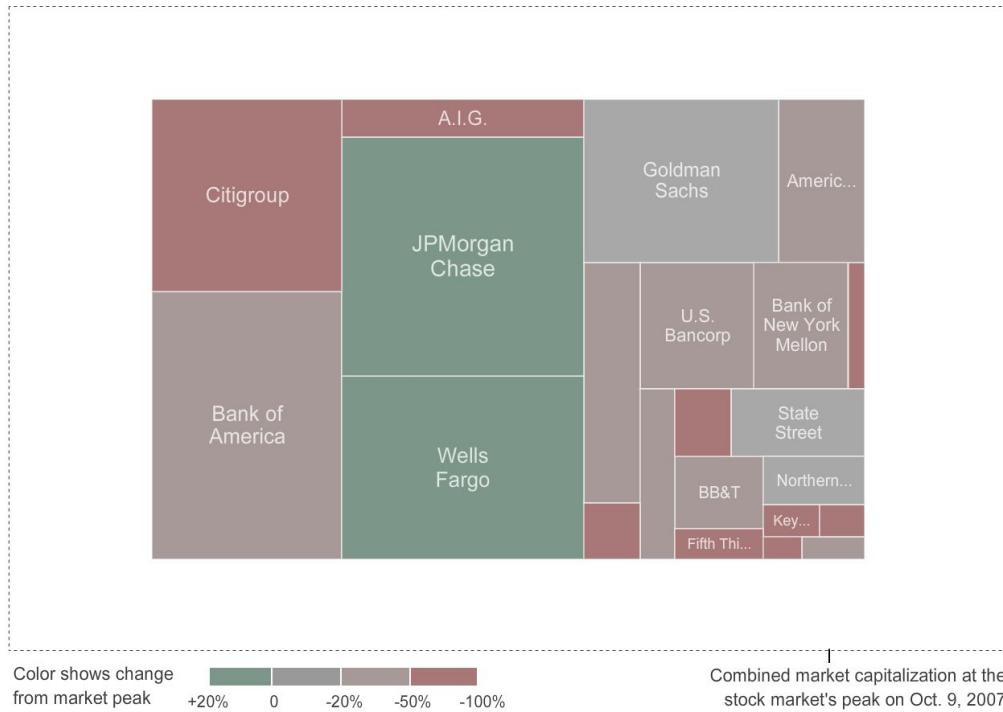


Figure 2: New layout scheme, described below

How the Giants of Finance Shrunk



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

DEMO

News Map

REGISTER LOGIN CUSTOMIZE + SELECT ALL ARGENTINA AUSTRIA BRAZIL CANADA FRANCE GERMANY INDIA ITALY MEXICO NETHERLANDS NEW ZEALAND SPAIN U.K. U.S. search all...

Political Paranoia Gets Expensive for Europe Bears Who Stay Away

Panera to add 10000 jobs by the end of 2017 as it expands delivery

Jimmy Choo on the Block As It Looks To Raise Luxury for Coffee

Boots to buy 824 million Boots Supply Deal

McLaren to team WilliamsF1 Takes On the Pitless Car

PPG Makes and Offers to Paint Fleet Absurdly

Lufthansa chief steps down after Syria

Indonesia to pay \$1.2 billion for Boeing 787

Supreme Court: Jack Ma Lawsuit

Wall Street comes in热 in real estate

German Business

NYC house fire kills 5, including children

The Latest: Mayor City won't be deterred in statue removal

Two officers will be charged after 4-year-old shot, police say

Arizona prepares for first double execution since 2003

Search continues for missing 6-year-old girl last seen in disappearance

Cross starts his 10th season with the Atlanta United

England

Can Bernie Sanders Save the Democratic Party?

Fate of the Furious' Continues to Dominate Global Box Office With \$908.4 Million Worldwide

'Fate of the Furious' Rules the Box Office Again as 'Unforgettable' and 'The Promise' Bomb

Kendrick Lamar sends off Coachella weekend 2 on a high note

Amber Heard and Elon Musk: Inside Their Romance

Amber Heard Dies in Update on Her Brother's Death After Her Rehabilitation

Colin Jost Opens Up About His Charged Relationship with His Wife

Onion Rides To Repeal The Right of Life After Arrest, Even When You Secretly Accused Of Criminal Manslaughter

North Korea detains US citizen Tony Kim; could it be "path forward"?

Maoist rebels kill at least 25 Indian paramilitary soldiers

New Advances in Space Tech Include a New Satellite, But no Return of Astronauts

Mobile Kenya, Ethiopia and Malawi get first satellite

Skye Freaming Out About Her Life and Living the Life Despite Her Condition

Calgary's First-Ever Street Art Festival Set to Open This Weekend

Monica Lewinsky, Anna Dello Russo and More

President Trump Must Officially Recognize the Armenian Genocide

Obama's hidden Iran deal giveaway

Tony Stark of Highest TV Ratings Shows in the World

Two people reportedly shot while driving vehicle

Trump's Plan to Cut Health Care Costs Could Cost Millions

Monica Lewinsky, Anna Dello Russo and More

Less Than 10 Min. Ago

More Than 10 Min. Ago

More Than 1 Hour Ago

Trump congratulates NASA astronaut who sets space record

The 2016 Orlando Girls Type R Is The Most Powerful Under-Charging King

These 10 Scandal Photos of Salem Show Why New Microsoft looks like LinkedIn does

Google's latest phone beat the Galaxy S7 edge

The failed park-Seminar Kerri Lonsdale county, the US college company, a new report says.

Google's latest phone beat the Galaxy S7 edge

Is this the beginning of LeBron James' end?

Even in playoff ouster, Maple Leafs gave Toronto a reason to believe again

Mets injury updates: Yoenis Cespedes, Lucas Duda and Asdrubal Cabrera

Aaron Hernandez's funeral set for Monday in hometown

Report: Saints, Patriots trade involving Butler appears unlikely

Take Thought: Potts for Apple's iPhone 7 coming down together, Louisville

Ruler of oil-rich Libya has been fighting back against Islamic State

Kiper builds Browns' perfect draft: Mocking all 11 picks

Skye Freaming: US Team Showdown: Warren祚和 India's Olympic Style of Cricket

Take Thought: Potts for Apple's iPhone 7 coming down together, Louisville

North Korea detains US citizen Tony Kim; could it be "path forward"?

President Trump Must Officially Recognize the Armenian Genocide

Obama's hidden Iran deal giveaway

Maoist rebels kill at least 25 Indian paramilitary soldiers

Trump's Plan to Cut Health Care Costs Could Cost Millions

Mobile Kenya, Ethiopia and Malawi get first satellite

Skye Freaming Out About Her Life and Living the Life Despite Her Condition

Calgary's First-Ever Street Art Festival Set to Open This Weekend

Monica Lewinsky, Anna Dello Russo and More

DEMO



Mon April 24, 2017 10:07:54

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+ SELECT ALL

WORLD

NATIONAL

BUSINESS

TECHNOLOGY

SPORTS

ENTERTAINMENT

HEALTH

LESS THAN 10 MIN. AGO

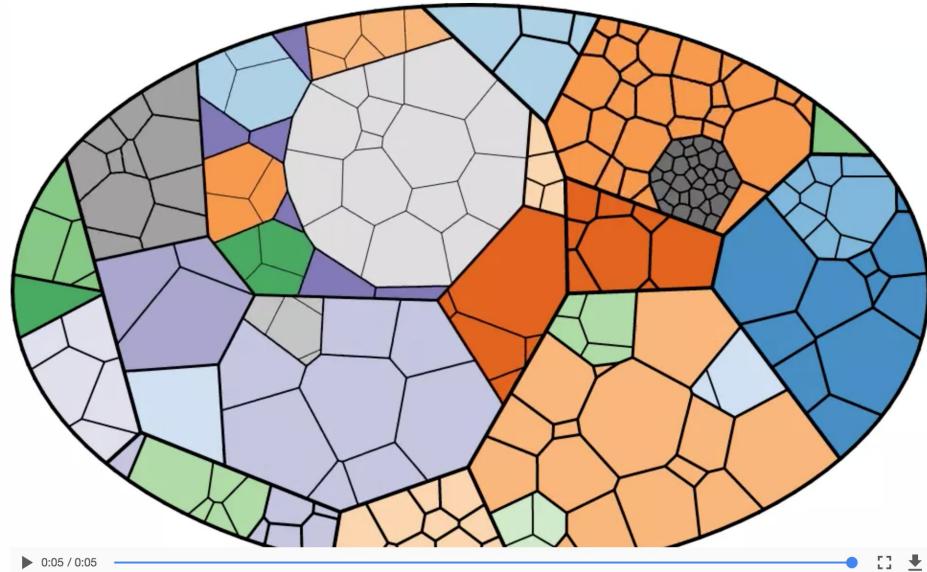
MORE THAN 10 MIN. AGO

MORE THAN 1 HOUR AGO

<http://newsmap.jp/>

Voronoi Treemaps

- Voronoi treemaps visualise hierarchical data by recursively partitioning convex polygons
- Polygon areas are proportional to the weights of their corresponding nodes



All of Inflation's Little Parts

Color shows change in prices from March 2007 to March 2008



ZOOM IN ZOOM OUT

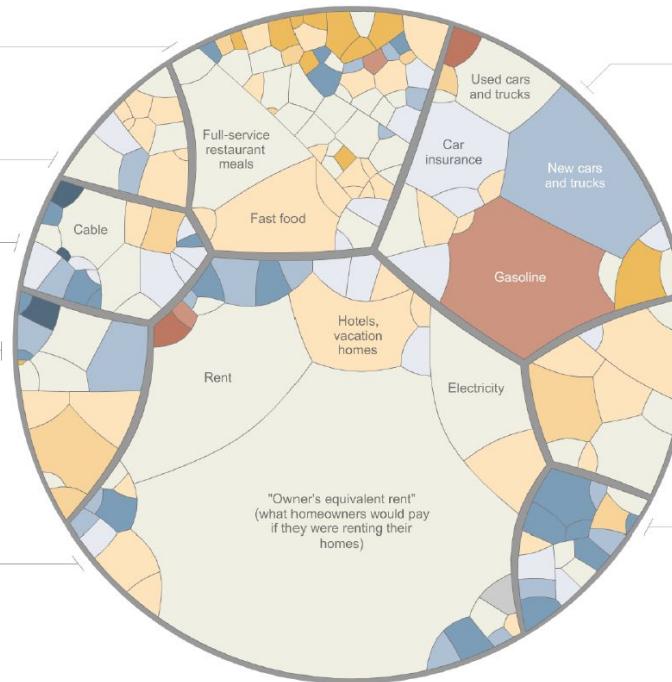
Food and beverages 15%
The high price of oil is a factor that has made food prices rise quickly.

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.



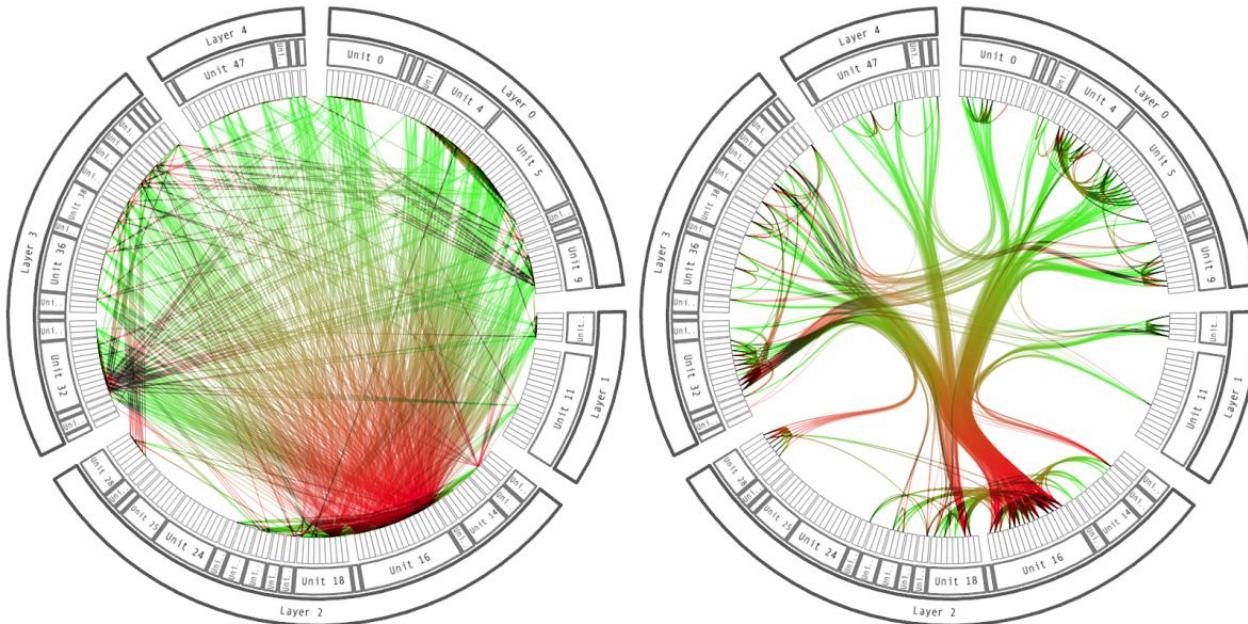
Transportation 18%
Gas is 5.2 percent of spending nationwide, but only 3.8 percent in the New York area.

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.

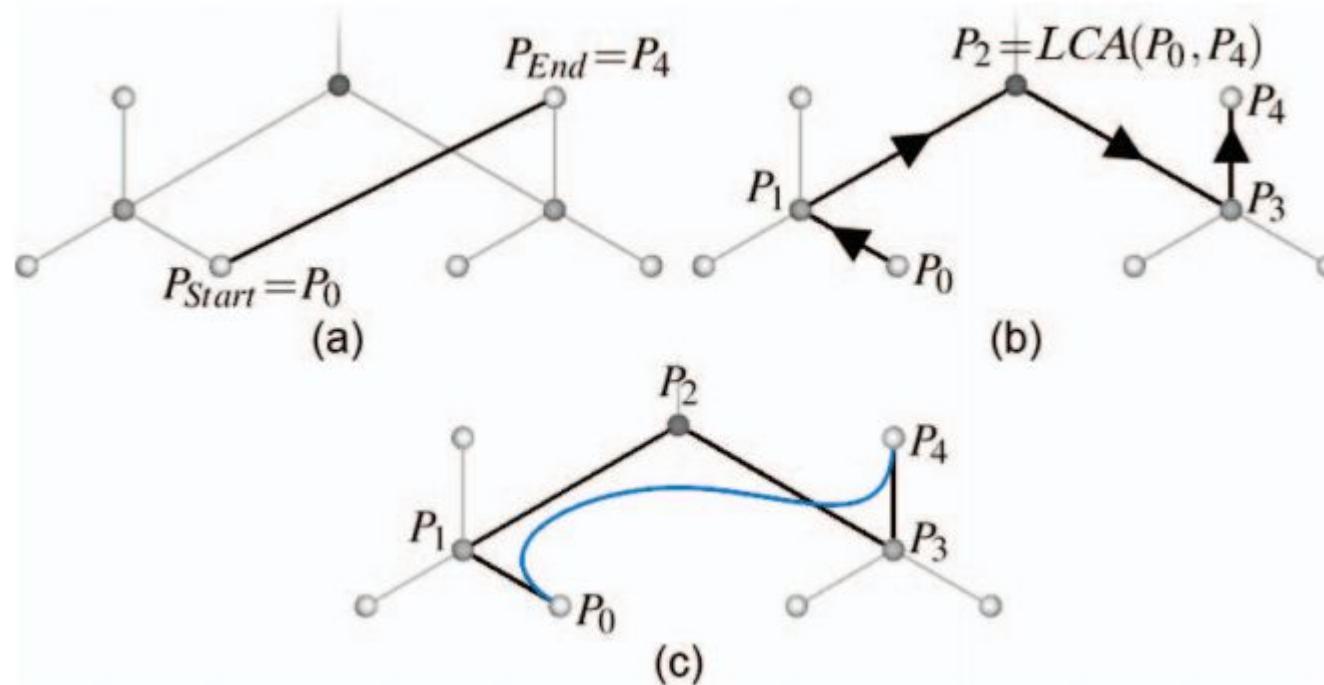
DEMO

Hierarchical Edge Bundles



Bundling adjacency edges

Bundling edges by using the available hierarchy



References

Design for Information. Isabel Meirelles Chapter 1.

bit.ly/shiny-quickstart-3

Customize shiny with HTML

How do you add content to a web page?

When writing HTML, you add content with **tags**.

<h1></h1>

<a>

How do you add content to a web page?

When writing R, you add content with **tags** functions.

`tags$h1() <h1></h1>`

`tags$a() <a>`

tags

Each element of the tags list is a function that recreates an html tag.

names(tags)

```
## [1] "a"          "abbr"        "address"      "area"  
## [5] "article"    "aside"        "audio"        "b"  
## [9] "base"        "bdi"         "bdo"         "blockquote"  
## [13] "body"        "br"          "button"       "canvas"  
## [17] "caption"     "cite"         "code"         "col"  
## [21] "colgroup"    "command"     "data"         "datalist"  
## [25] "dd"          "del"          "details"      "dfn"  
## [29] "div"          "dl"          "dt"          "em"  
## [33] "embed"        "eventsourc"  "fieldset"     "figcaption"  
## [37] "figure"       "footer"       "form"        "h1"  
## [41] "h2"          "h3"          "h4"          "h5"
```

Tag syntax

```
tags$a(href = "www.rstudio.com", "RStudio")
```

the list
named tags

the function/tag name
(followed by parentheses)

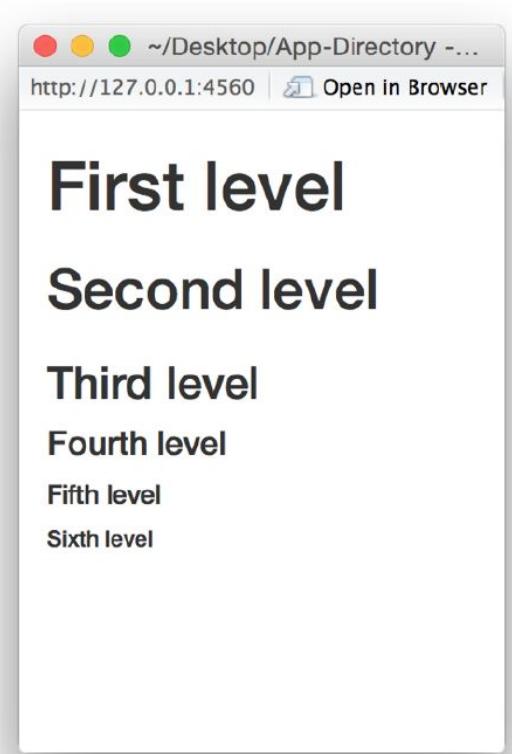
named arguments
appear as tag attributes
(set boolean attributes to NA)

unnamed arguments
appear inside the tags
(call tags\$...() to create nested tags)

```
<a href="www.rstudio.com">RStudio</a>
```

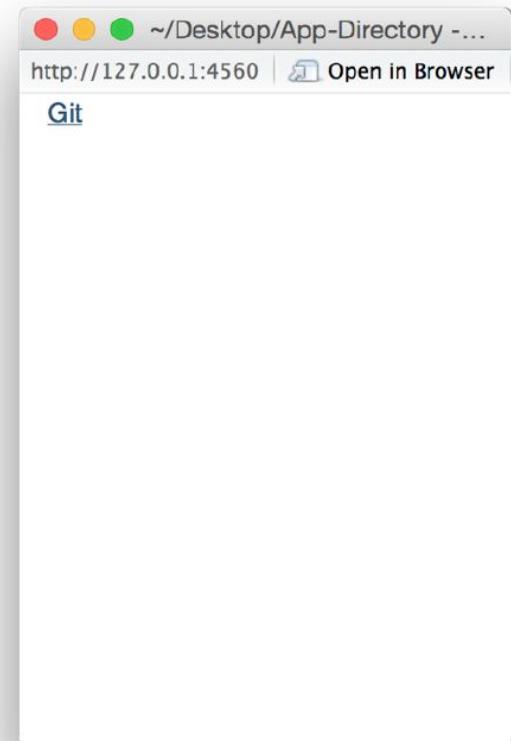
Headers

```
fluidPage(  
  tags$h1("First level"),  
  tags$h2("Second level"),  
  tags$h3("Third level"),  
  tags$h4("Fourth level"),  
  tags$h5("Fifth level"),  
  tags$h6("Sixth level"))
```



a() hyperlink with the href argument

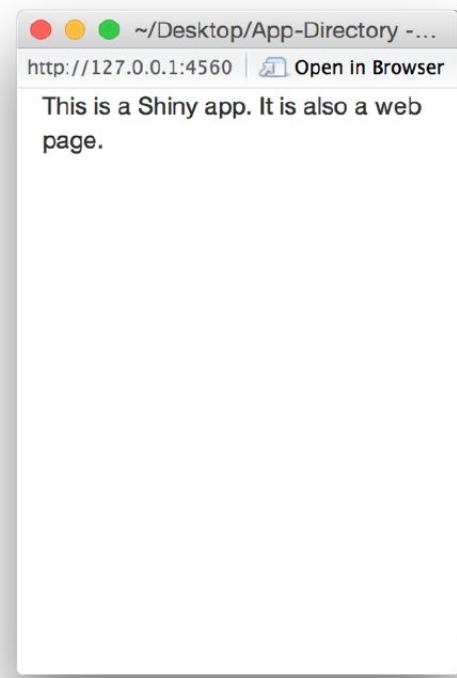
```
fluidPage(  
  tags$a(href= "http://www.git.com",  
    "Git")  
)
```



Text

Character strings do not need a tag

```
fluidPage(  
  "This is a Shiny app.",  
  "It is also a web page."  
)
```



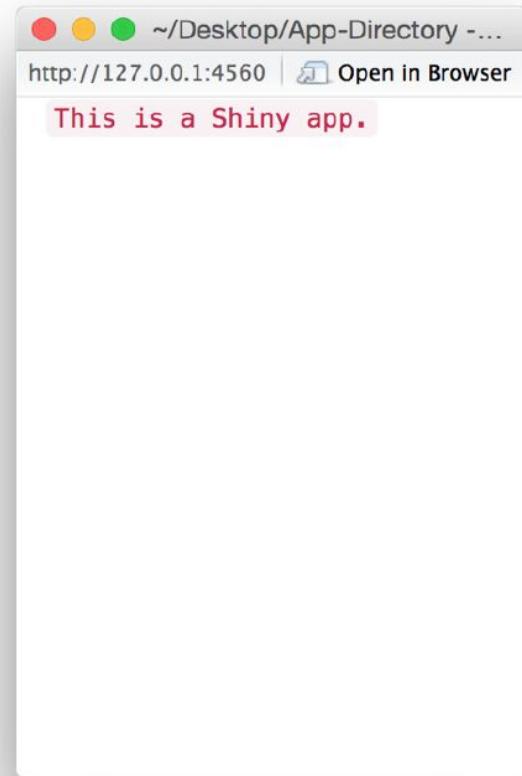
p() new paragraph

```
fluidPage(  
  tags$p("This is a Shiny app."),  
  tags$p("It is also a web page.")  
)
```



code()

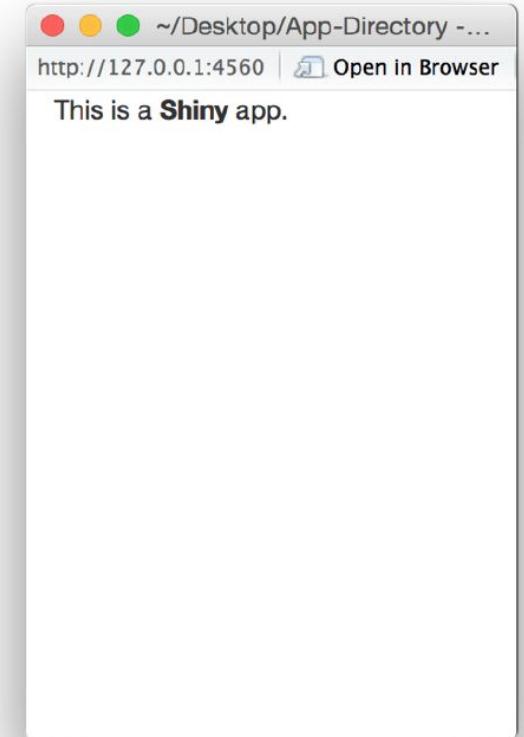
```
fluidPage(  
  tags$code("This is a Shiny app.")  
)
```



Nesting

You can also nest functions inside of others

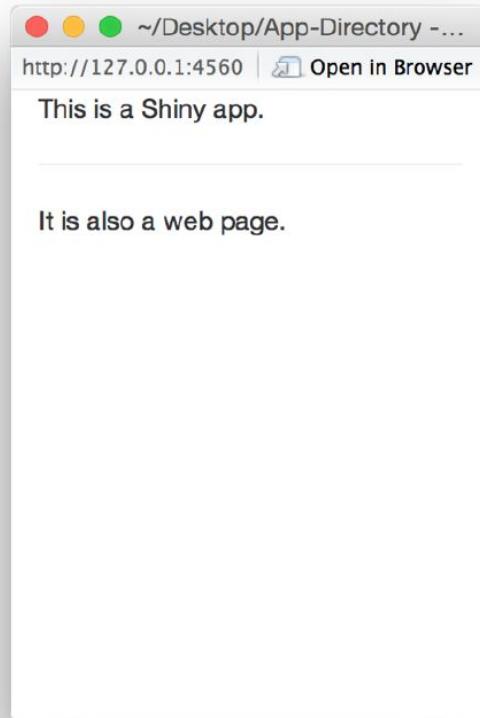
```
fluidPage(  
  tags$p("This is a",  
         tags$strong("Shiny"),  
         "app.")  
)
```



hr()

A horizontal rule

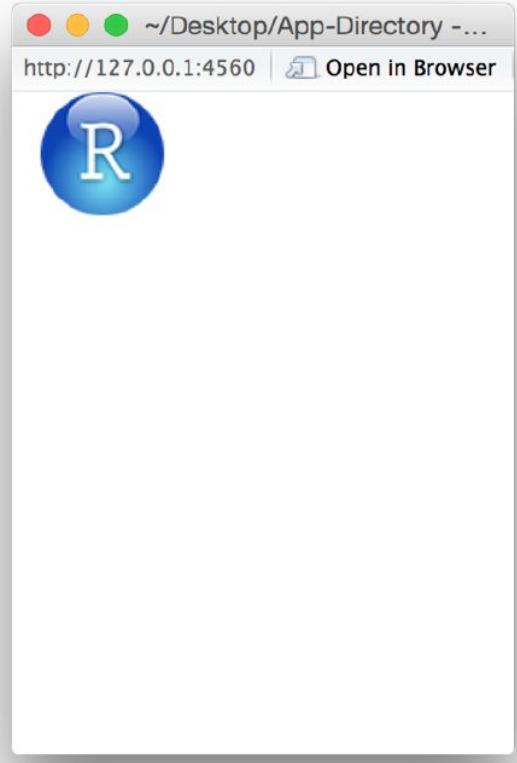
```
fluidPage(  
  "This is a Shiny app.",  
  tags$hr(),  
  "It is also a web page."  
)
```



img()

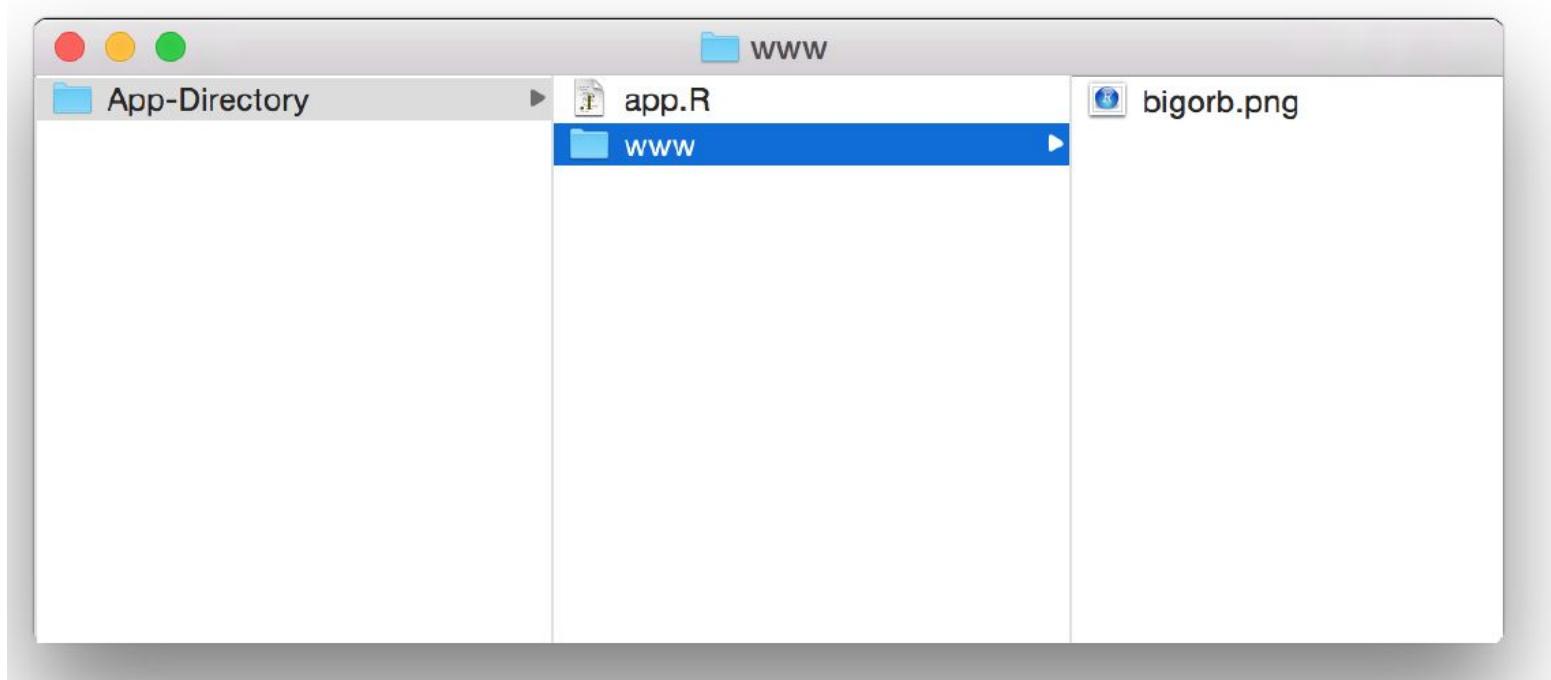
Add an image. Use `src` argument to point to the image URL.

```
fluidPage(  
  tags$img(height = 100,  
            width = 100,  
            src = "http://www.rstudio.com/  
                    images/RStudio.2x.png"))  
)
```



Adding Images

To add an image from a file, save the file in a subdirectory named [www](#)



img()

Add an img from a file in www

```
fluidPage(  
  tags$img(height = 100,  
            width = 100,  
            src = "bigorb.png")  
)
```

