

# DATA VISUALIZATION AND VISUAL ANALYTICS

S. Rinzivillo – [rinzivillo@isti.cnr.it](mailto:rinzivillo@isti.cnr.it)

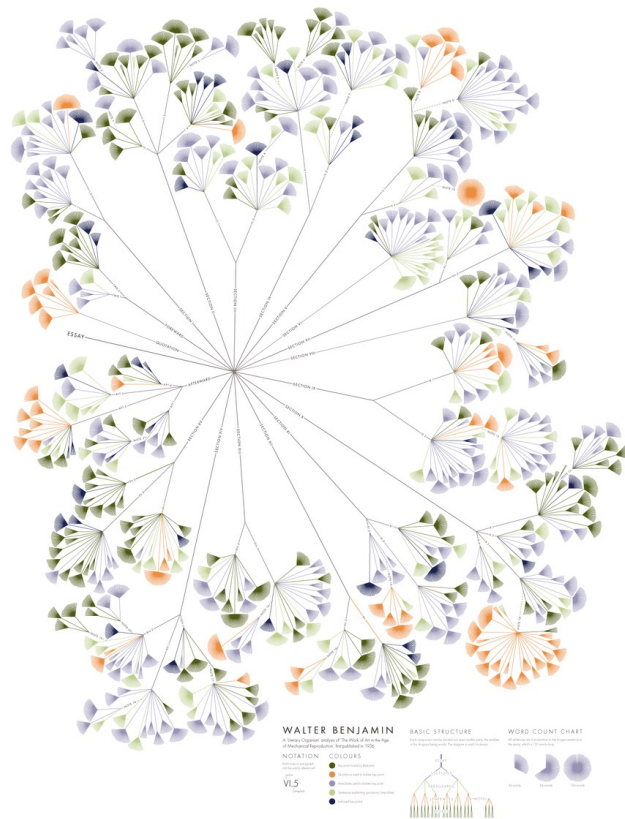
# HIERARCHY

- Oxford Dictionary:
  - a system in which members of an organization or society are ranked according to relative status or authority
  - an arrangement or classification of things according to relative importance or inclusiveness
- Hierarchical systems are ordered sets where elements are organized in a given relationship to one another
  - Parent-node relationship
  - Sibling relationship

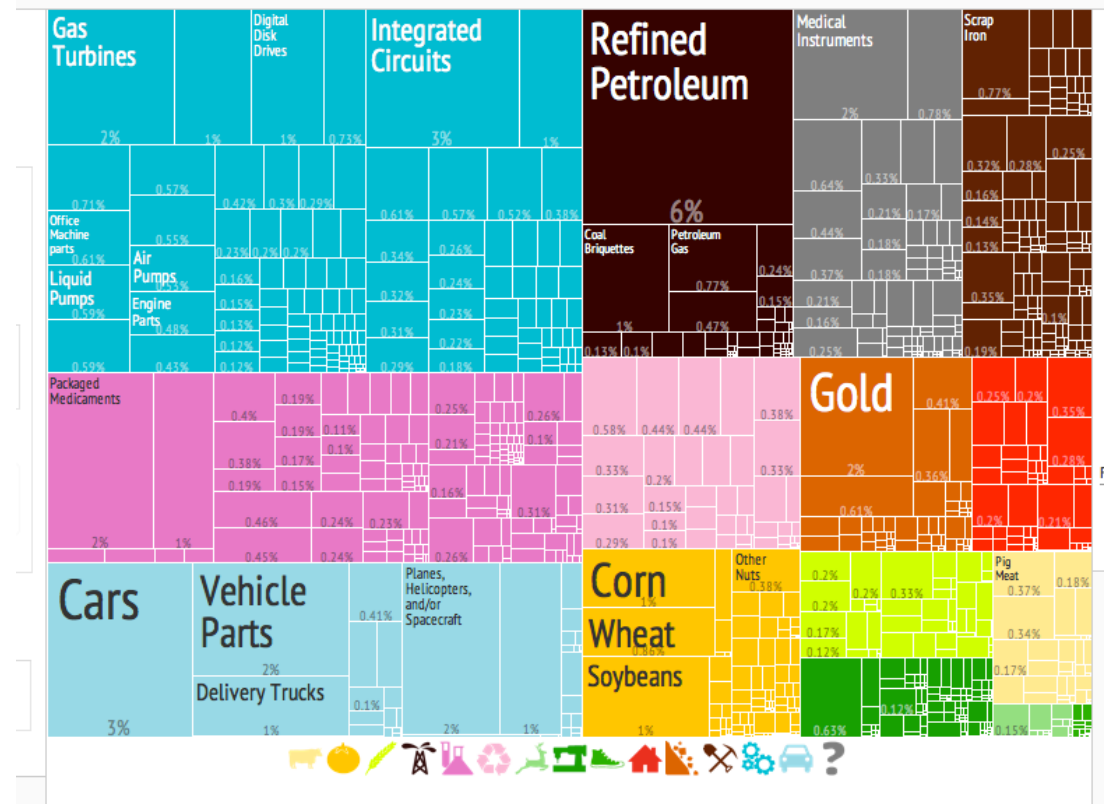
# HIERARCHY

- Complexity often takes form of hierarchy
- Hierarchy is one of the central structures to represents complexity

# HIERACHICAL STRUCTURES



What did the United States export in 2011?



<http://www.stefanieposavec.co.uk/entangled-word-bank/>

<http://atlas.media.mit.edu/>

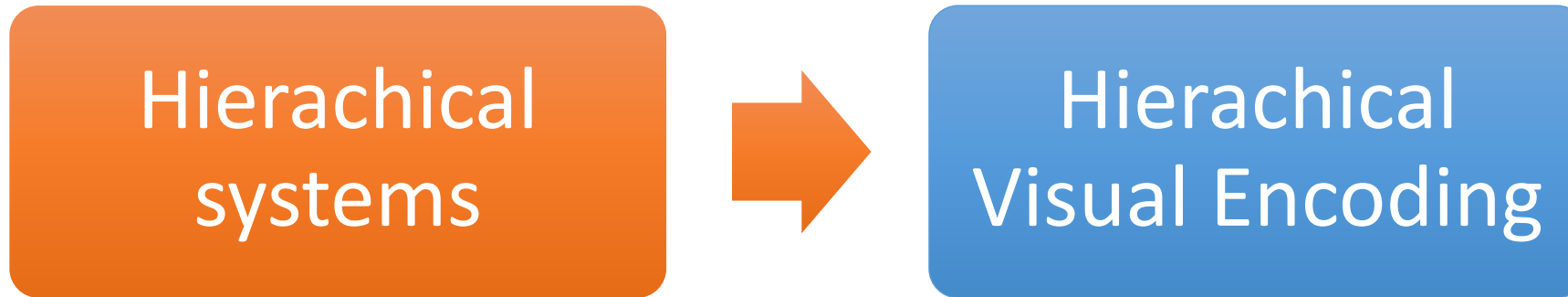
# REPRESENTATION

- Two main visualization approaches
  - Stacked
    - Higher ranks are arranged in a directional relationship
      - Vertically, top to bottom
      - Horizontally, left to right, right to left
      - Centrally, center to periphery
    - Lines connect elements in the sets
      - One-dimensional visual elements
  - Nested

# REPRESENTATION

- Two main visualization approaches
  - Stacked
  - Nested
    - Elements organized in containers
    - Higher ranking elements contains lower ranked ones
    - Container is a geometric object: two-dimensional plane, three dimensional solid
    - Container provides the grouping for all the descendant

# VISUAL HIERARCHIES



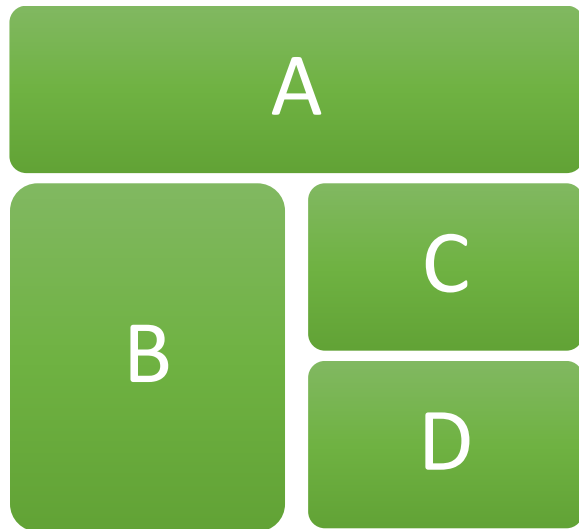
- Spatial encoding is crucial for visualization
- Two separate cognitive processes
  - Spatial properties (position and size)
  - Object properties (shape, color, texture, etc.)

# PROXIMITY

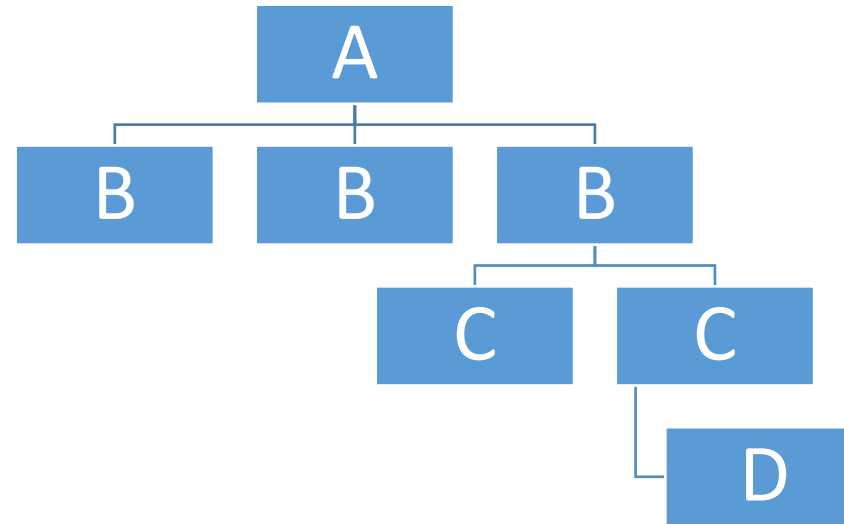
Proximity describes the tendency to group visual elements that are near one another

Visual proximity (should) corresponds to real proximity

## Physical Systems

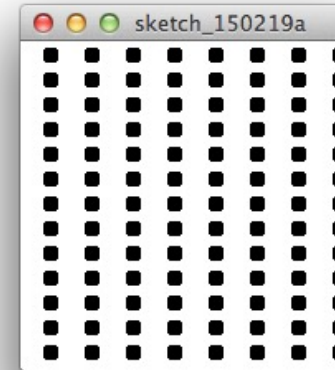
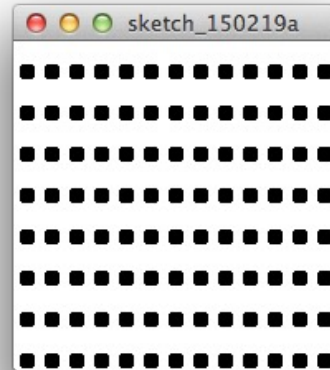
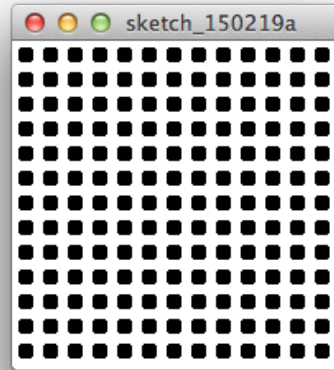


## Abstract Systems





# PROXIMITY, GROUPS, CLUSTERS



- Space between dots allows us to perceive groups as columns or rows
- Spatial proximity facilitate the detection of related data
- Conceptually related concepts should be represented spatially close

# HIERARCHICAL ABSTRACT DOMAINS

- Abstract domains usually do not provide visual clues
- Assigning a visual representation to abstract data is crucial for a robust visualization

# VISUAL TAXONOMY

## The Data Visualisation Catalogue

About · Suggest · Shop · Resources

Search by Function

View by List



Arc Diagram



Area Graph



Bar Chart



Box & Whisker Plot



Brainstorm



Bubble Chart



Bubble Map



Calendar



Chord Diagram



Choropleth Map



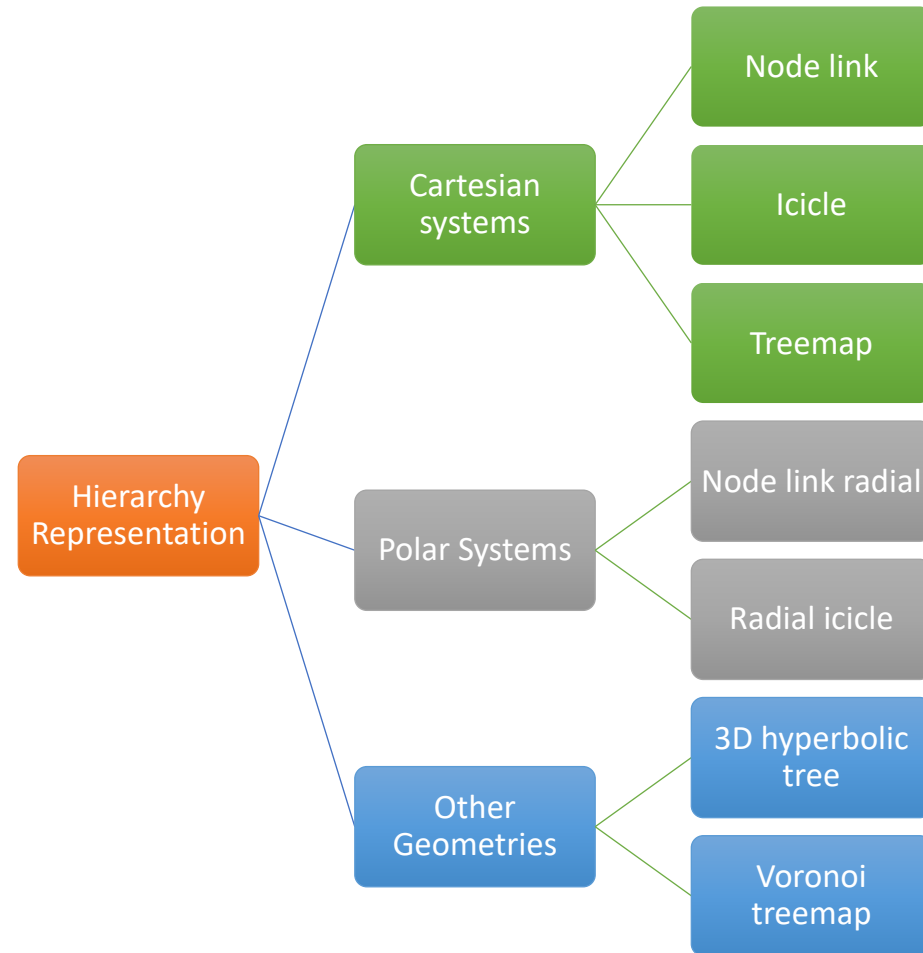
Circle Packing



Connection Map

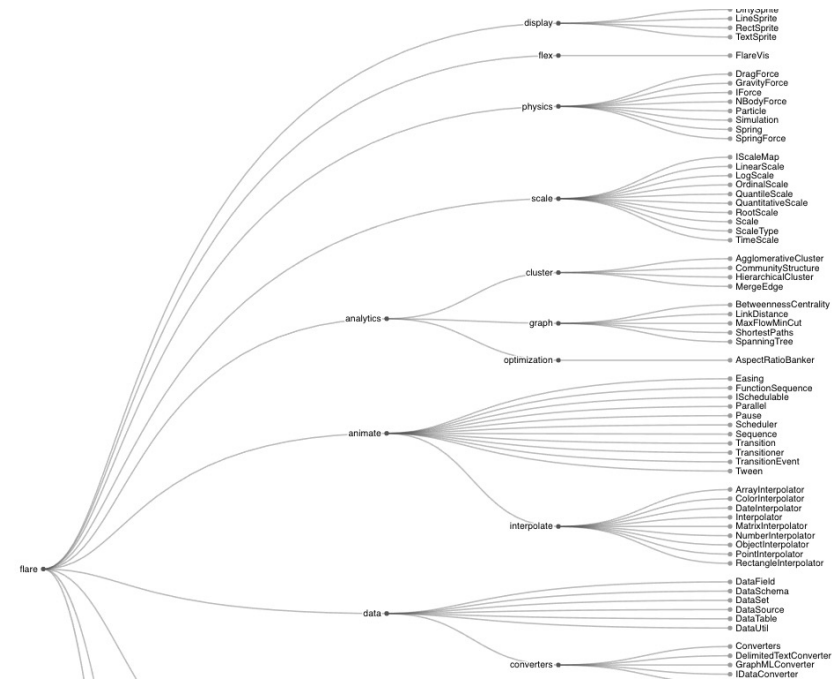


# TAXONOMY OF VISUAL REPRESENTATIONS



# NODE LINK LAYOUT

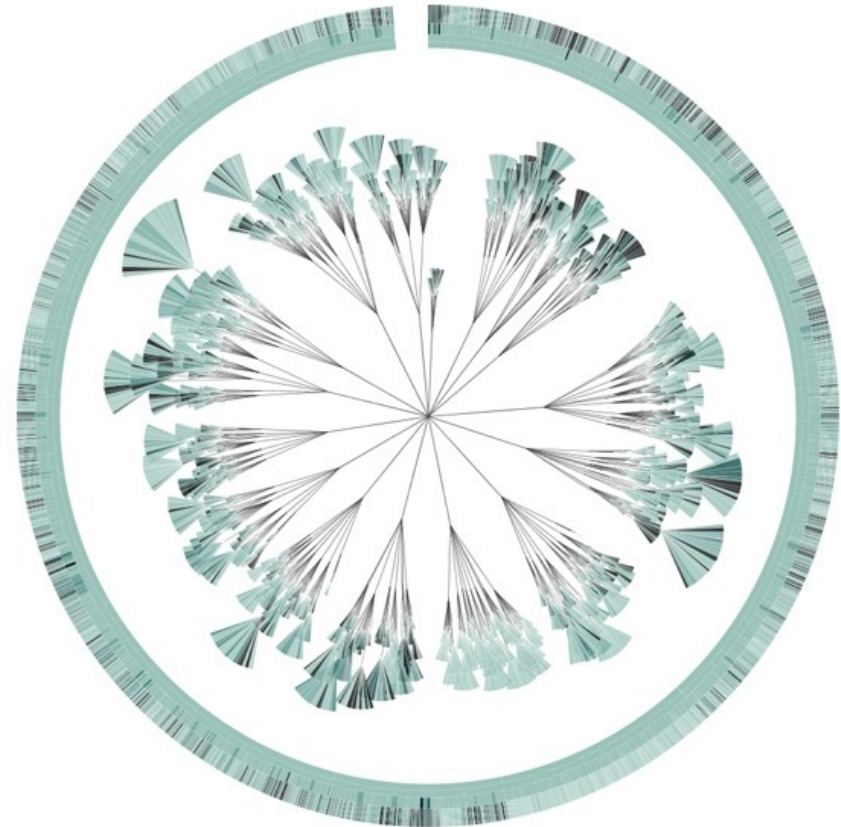
- Stacked scheme
- Node link
- Direction for arrangement
  - Vertically
  - Horizontally
  - Centrally
- Sometimes lines encode properties of the relationship



<https://observablehq.com/@d3/cluster-dendrogram>

# NODE LINK LAYOUT

- Stacked scheme
- Node link
- Direction for arrangement
  - Vertically
  - Horizontally
  - Centrally
- Sometimes lines encode properties of the relationship

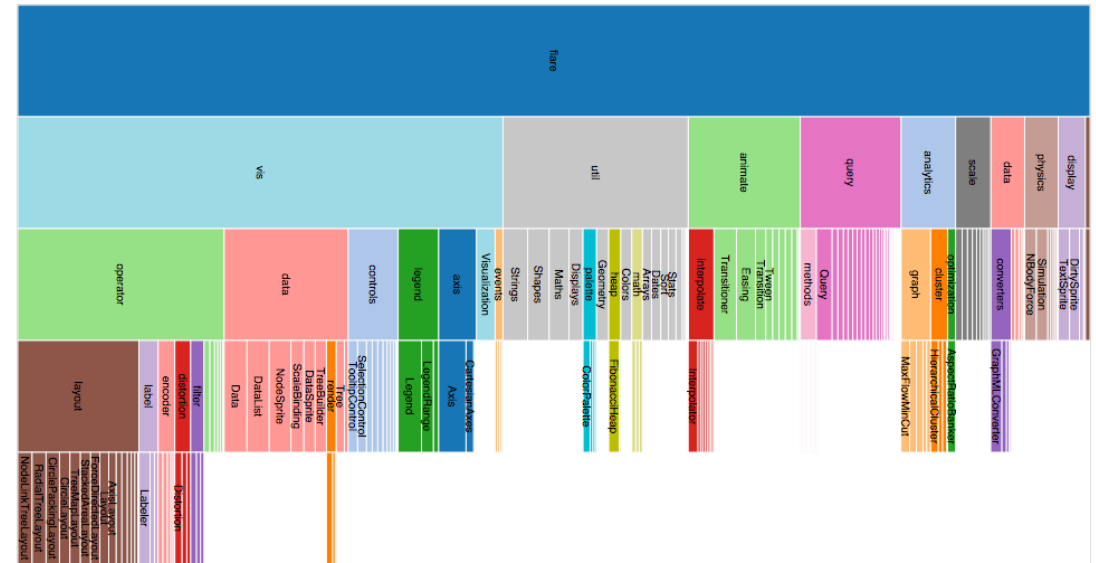


<http://research.microsoft.com/en-us/projects/TextVis/>

<https://observablehq.com/@d3/radial-tidy-tree>

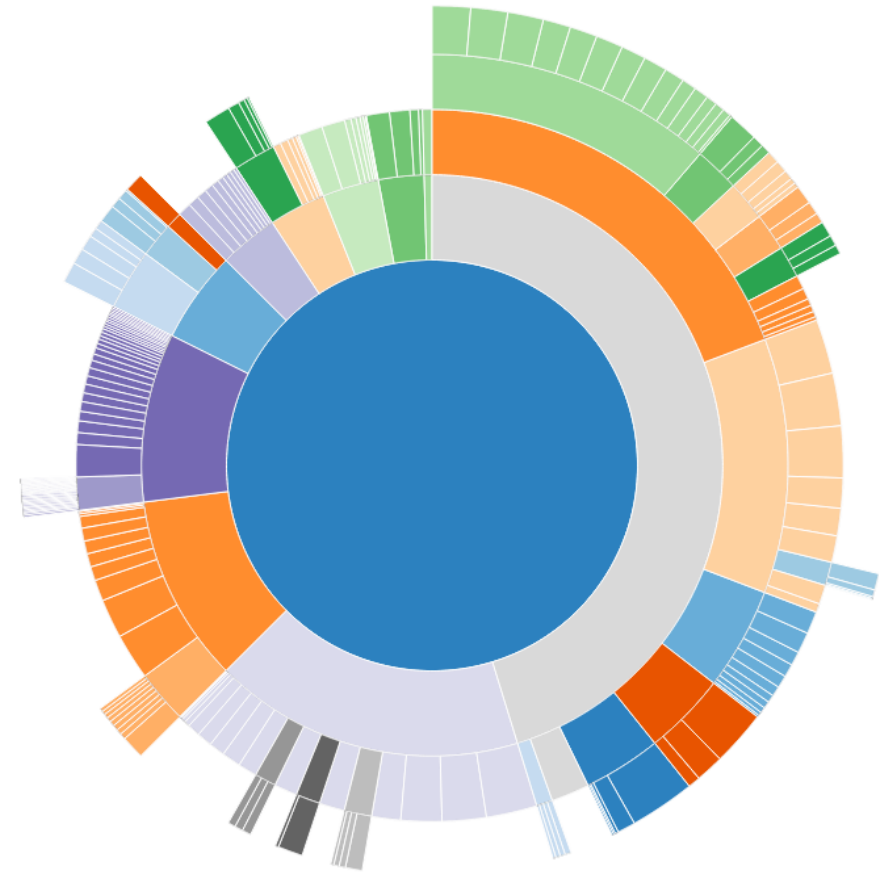
# ICICLE LAYOUT

- Stacked scheme
- Direction for arrangement
  - Vertically
  - Horizontally
  - Centrally
- Height/color of each shape/node may encode properties



# RADIAL ICICLE LAYOUT

- Stacked scheme
- Direction for arrangement
  - Vertically
  - Horizontally
  - Centrally
- Height/color of each shape/node may encode properties

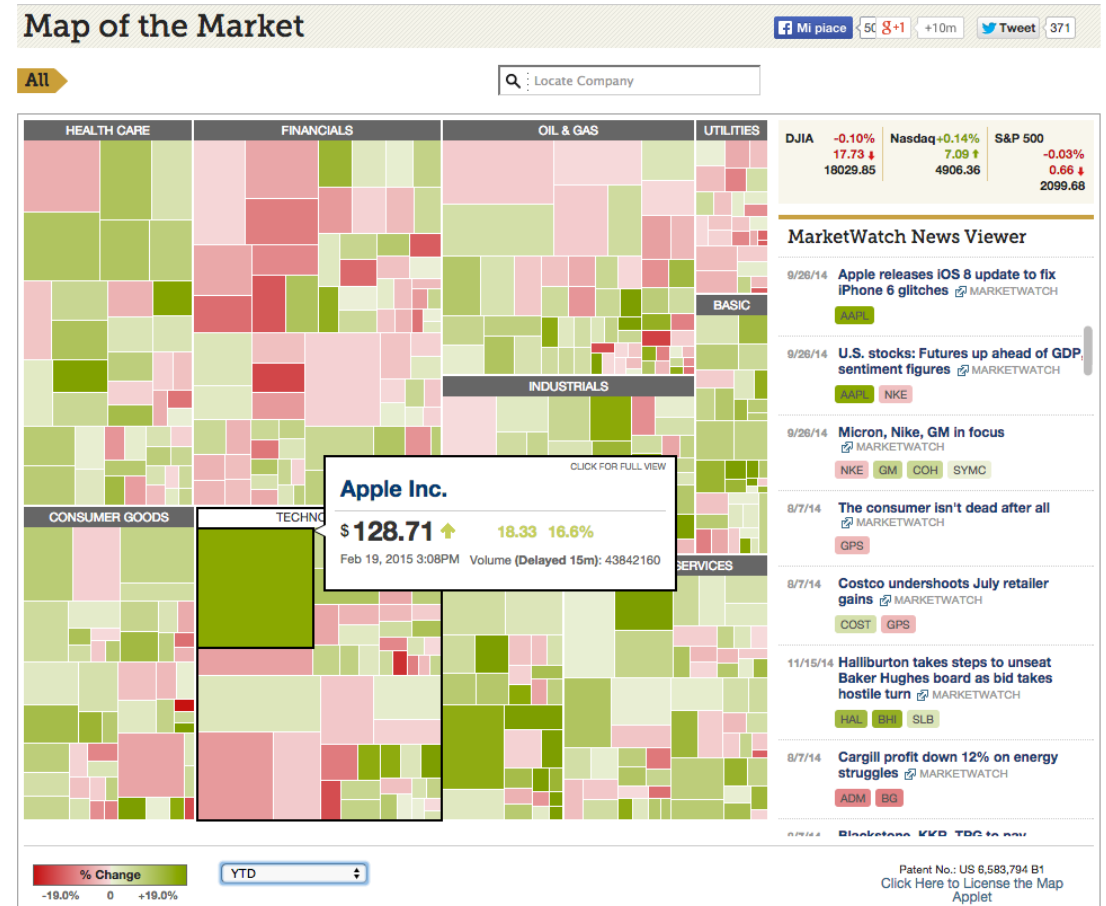


<https://observablehq.com/@d3/sunburst>



# TREEMAP LAYOUT

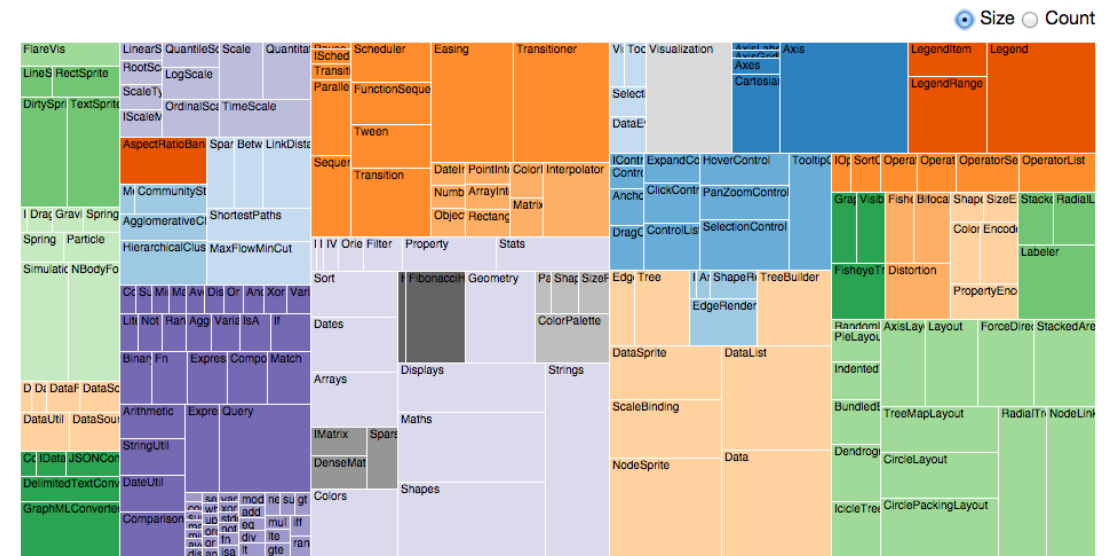
- Container scheme
- No direction for arrangement
- Height/color of each shape/node may encode properties
- Usually additional linked display are useful to explore data



<http://www.marketwatch.com/tools/stockresearch/marketmap>

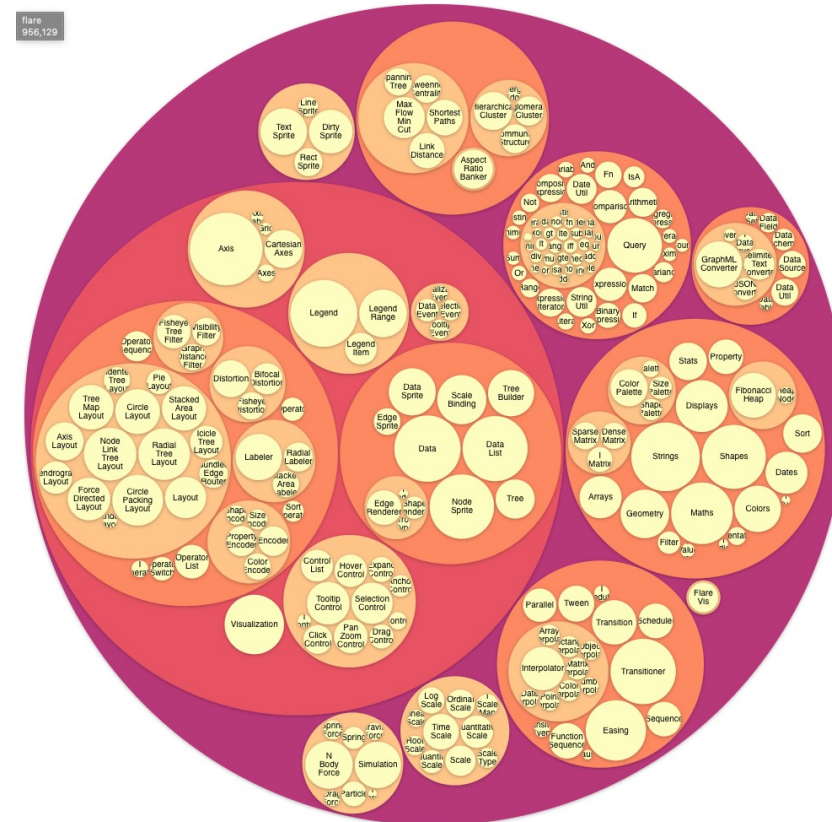
# TREEMAP LAYOUT

- Container scheme
- No direction for arrangement
- Height/color of each shape/node may encode properties
- Usually additional linked display are useful to explore data



# TREEMAP LAYOUT

- Container scheme
- No direction for arrangement
- Height/color of each shape/node may encode properties
- Usually additional linked displays are useful to explore data



<https://observablehq.com/@d3/circle-packing>

# VORONOI TREEMAP

May 3, 2008

## All of Inflation's Little Parts

Each month, the Bureau of Labor Statistics gathers 84,000 prices in about 200 categories — like gasoline, bananas, dresses and garbage collection — to form the Consumer Price Index, one measure of inflation.

It's among the statistics that the Federal Reserve considered when it cut interest rates on Wednesday. The categories are weighted according to an estimate of what the average American spends, as shown below.

SIGN IN TO E-MAIL OR SAVE THIS | FEEDBACK

### An Average Consumer's Spending

Each shape below represents how much the average American spends in different categories. Larger shapes make up a larger part of spending.

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%

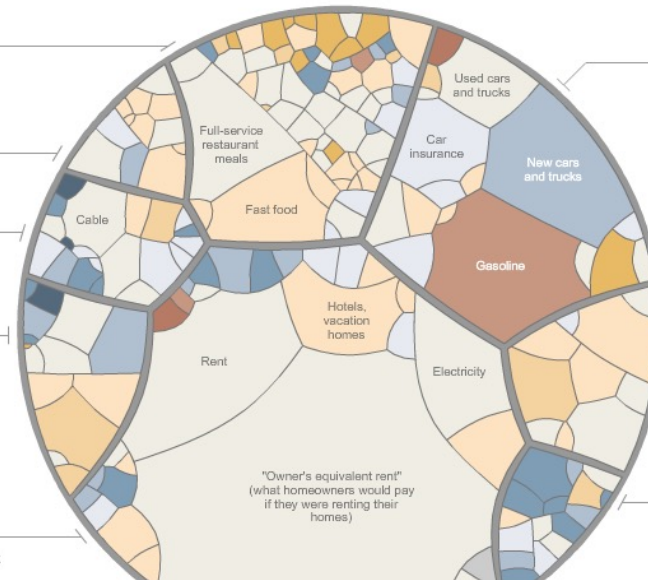
#### Recreation 6%

#### 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



#### 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?\\_r=0](http://www.nytimes.com/interactive/2008/05/03/business/20080403_SPENDING_GRAPHIC.html?_r=0)

# LAYOUTS



# LAYOUTS

- A layout encapsulate a strategy to position elements on the screen
- For example: alignment along a reference axis
  - Exploit `d3.scale` to handle the projection on the screen

# LAYOUT

- A layout works on **a set of elements** (unlike for selection)
- In d3, a layout enriches the input data to provide new properties to determine the position on the screen

# AVAILABLE LAYOUTS

- D3 provides a vast library of layouts
  - **Hierarchies**  
<https://github.com/d3/d3-hierarchy>
  - **Chords**  
<https://github.com/d3/d3-chord>
  - **Force**  
<https://github.com/d3/d3-force>

