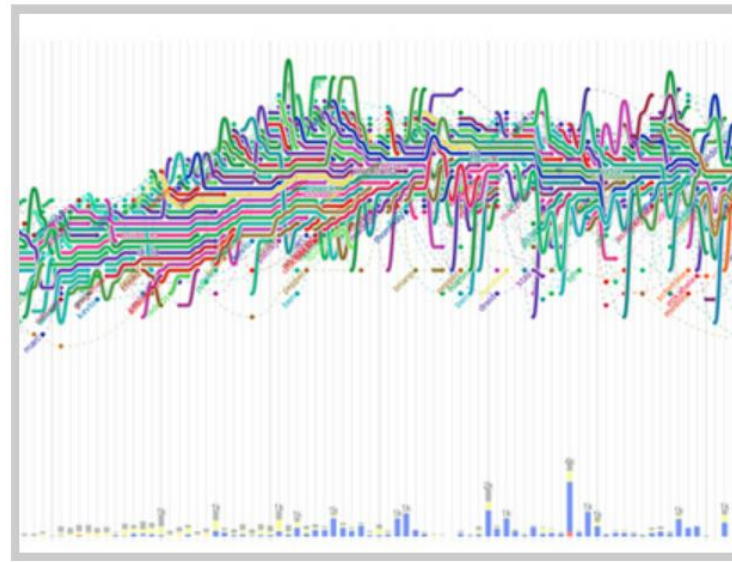




Representation- II

Encoding relation



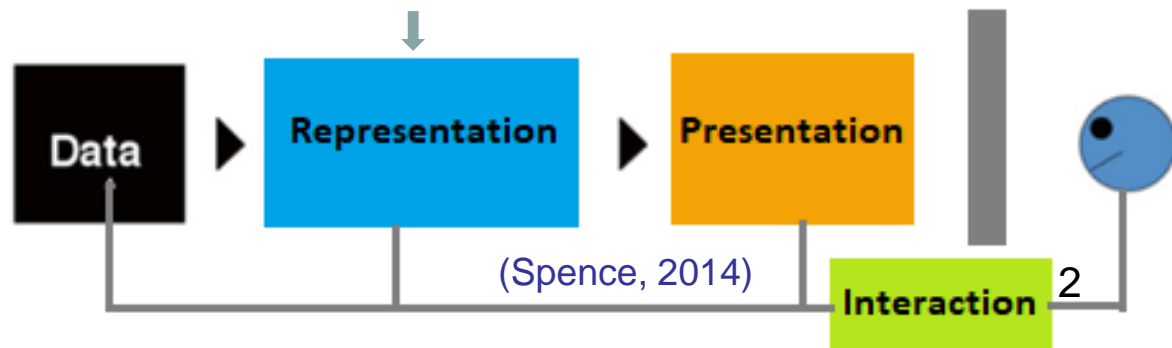
visualcomplexity.com

- Two types of data:
 - Value (already addressed)
 - Relation

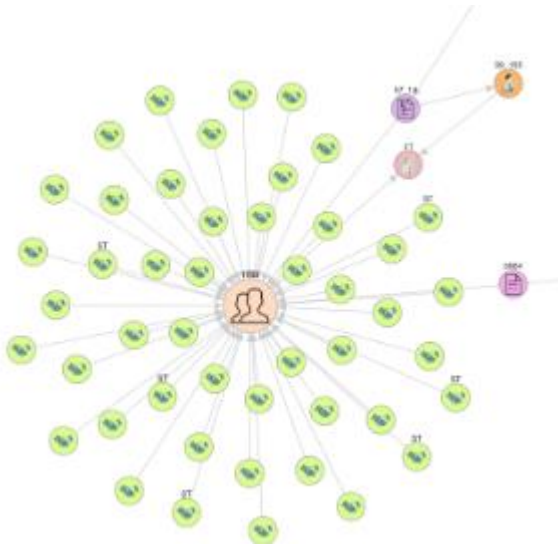
- What is relation?

A logical or natural association between two or more things; relevance of one to another; connection (in dictionary)

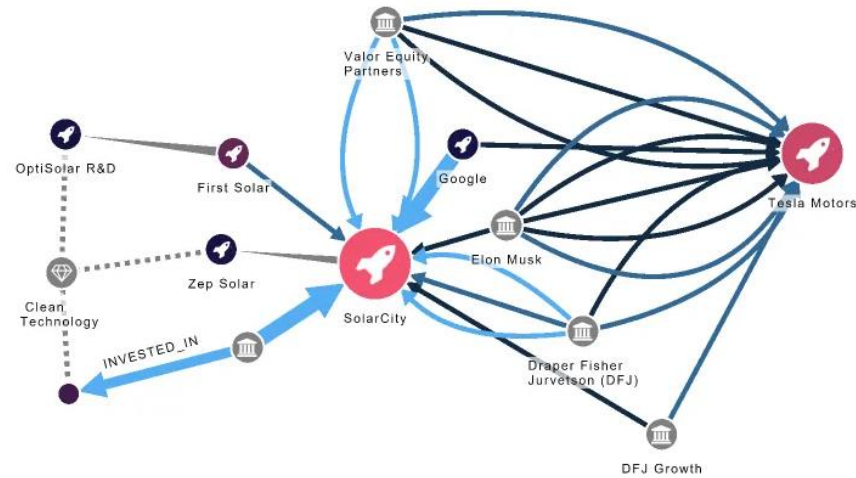
- How to represent relation?



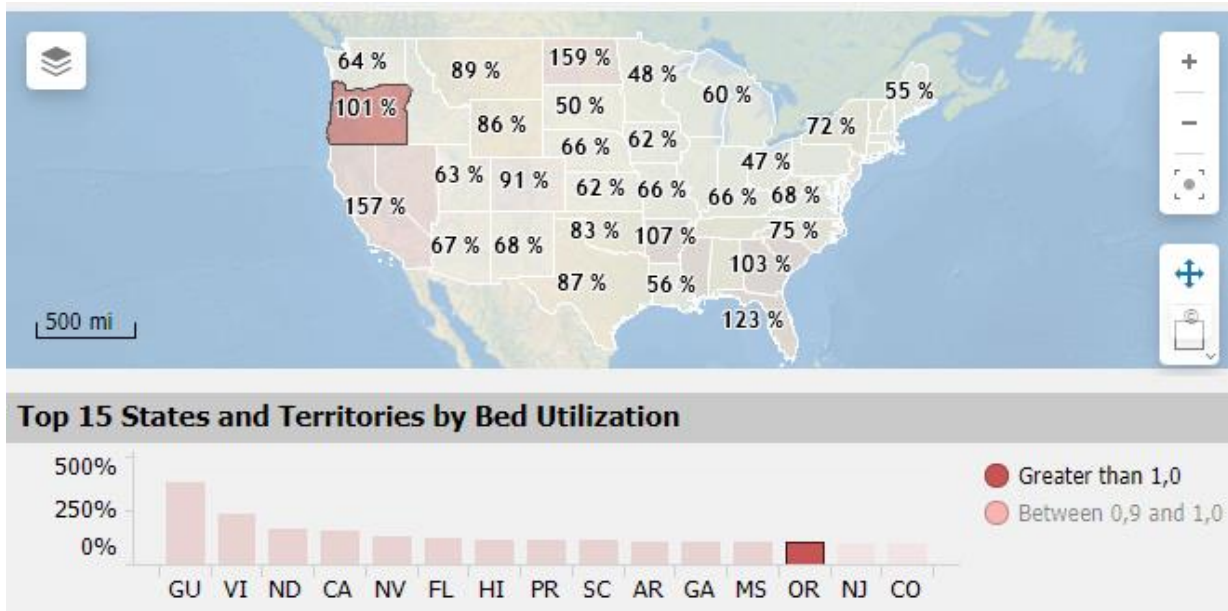
Several ways to represent relation:



Lines indicate relationship



Arrows indicate unique unilateral functional relations

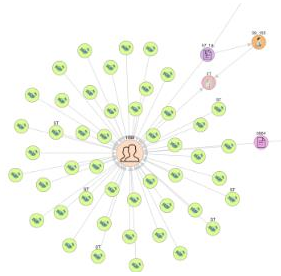


Color indicates a relation between representations

- The nature of relations is different from values
- However, the prime considerations in the choice of a representation are similar:
 - an understanding of the task
 - the insight that is sought
 - what questions might be asked of the relation
- Some representations of relation are very simple, yet powerful

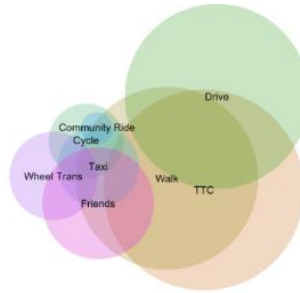
Encoding relation

- Lines

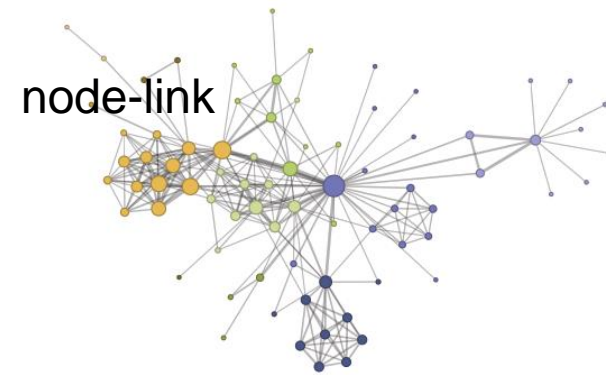


- Diagrams

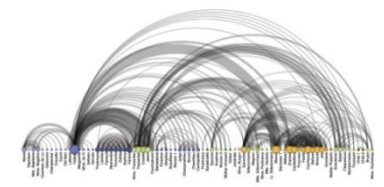
Venn diagrams



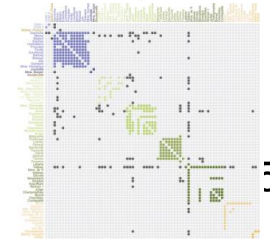
- Networks



Arc

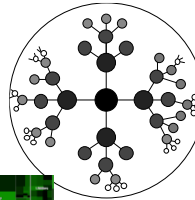


Matrix



- Trees

Hyperbolic browser



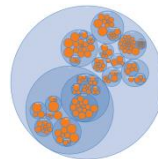
Treemap



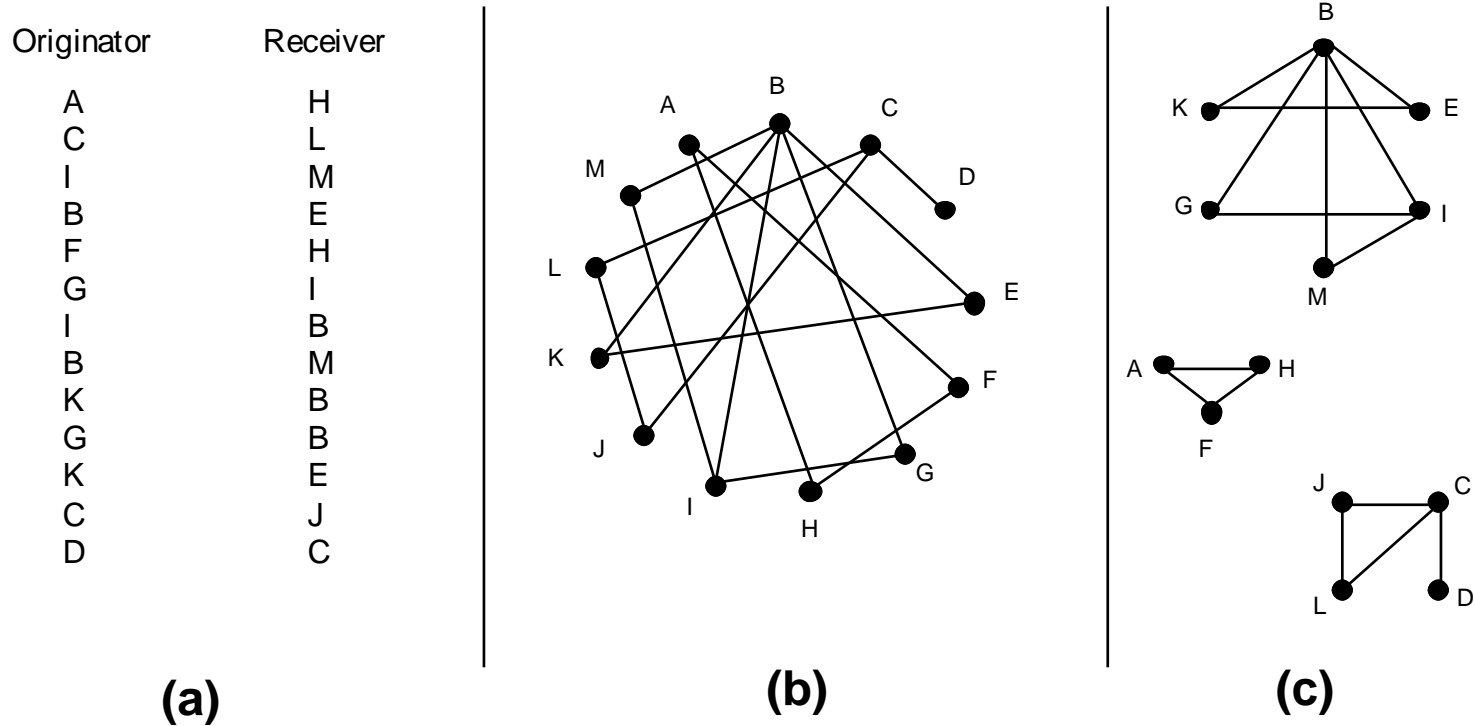
Sunburst



Nested circles



- **Lines** are perhaps the simpler way to represent a relation between two entities



Insight into even a short list of telephone calls (a) is enhanced by their node-link representation (b), especially if disconnected subsets can be identified (c).

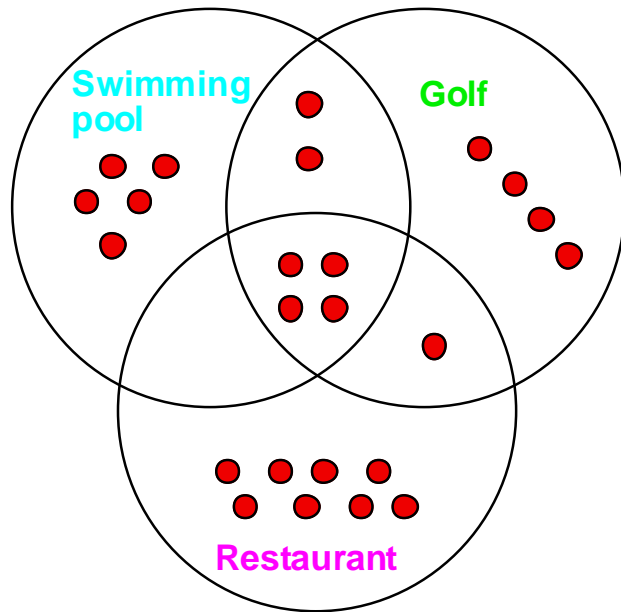
(Spence, 2007)

Perhaps the most familiar use of lines to represent relations is in transportation maps



Harry Beck's original London Underground map (1933) (Spence, 2007)

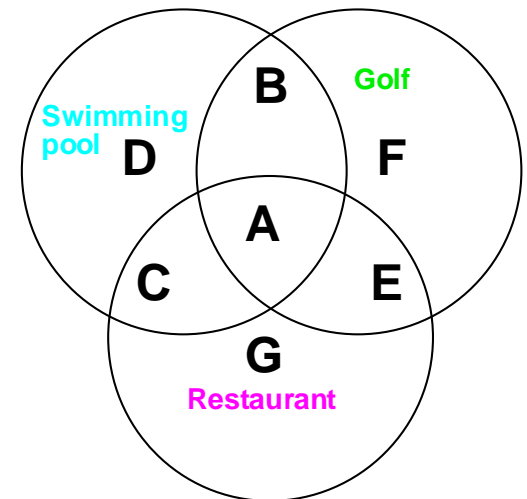
- **Venn diagrams** make easier the search of an object verifying a set of logical relations



A Venn Diagram representation of the attributes of 24 hotels

	Swimming Pool	Golf Course	Restaurant
A	●	●	●
B	●	●	
C	●		●
D	●		
E		●	●
F		●	
G			●

Facilities offered by eight hotels



(Spence, 2007)

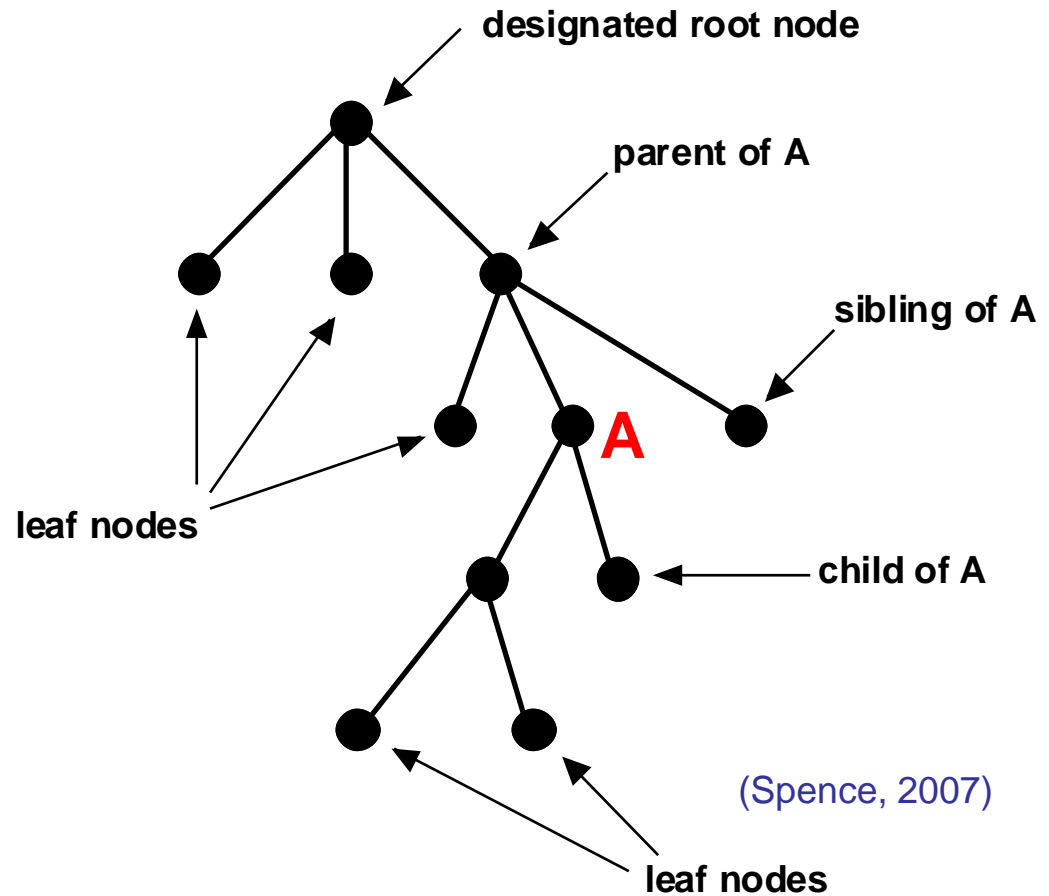
- The previous representations show relations with no restriction upon what is connected (**networks**)

- **Trees** are a class of networks which have no loops

- There are several common representations:

- tree maps
- hyperbolic browser
- sunburst

...

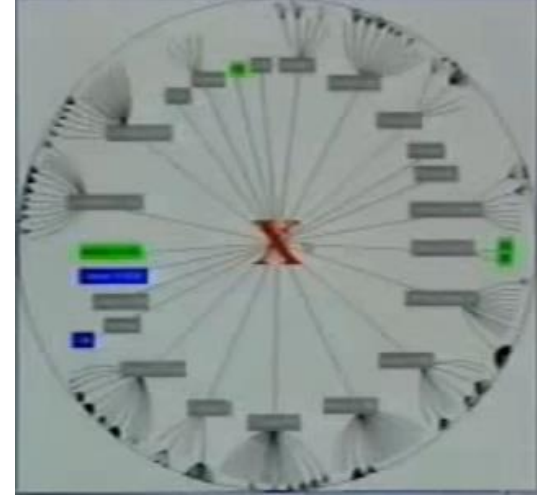


- The **Hyperbolic Browser** (Lamping et al., 1995) represents a tree within a circle

- It is based on a hyperbolic geometric transformation:

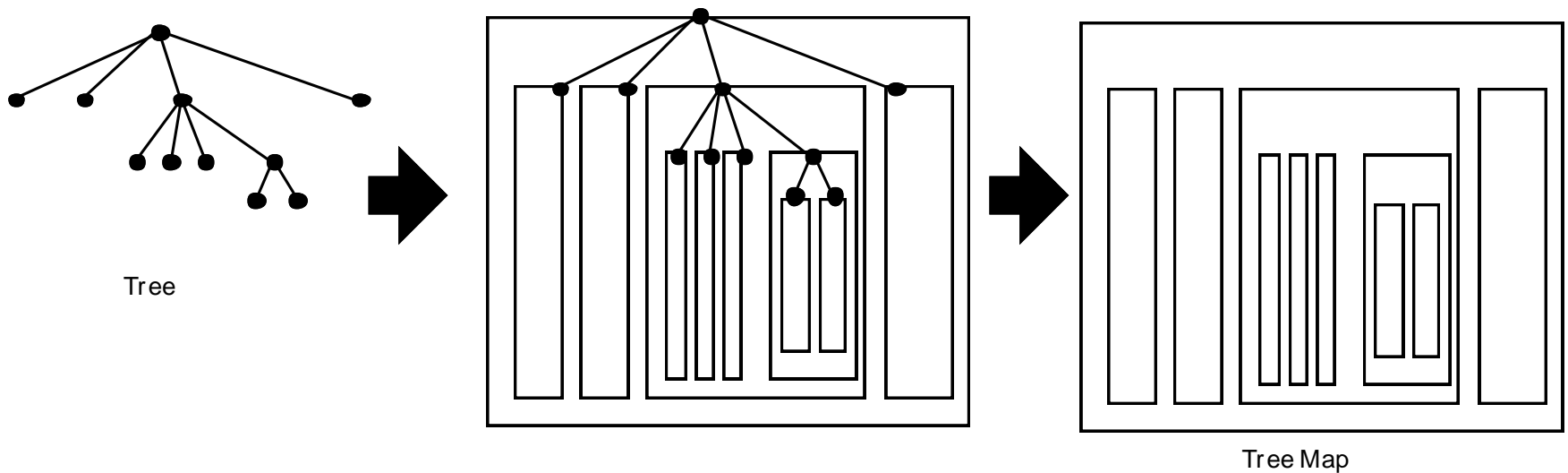
- the designated root node is at the center
- its children are distributed around it at a particular distance
- as the number of levels increase:
 - the distance between each node and its parent decreases
 - the size of the node also decreases
- drawing stops at one pixel resolution

- The principal advantage is its interactive nature: any node of interest can be moved to the center

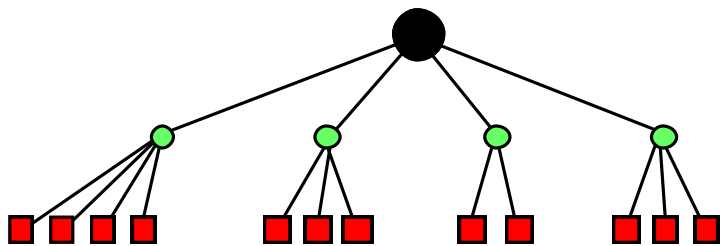


<http://www.youtube.com/watch?v=pwpze3RF55o>

- The **Treemap** (Jonhson and Shneiderman, 1991) is another representation of a tree:
 - the root node is represented by a rectangle (usually as large as possible)
 - within this rectangle there are smaller rectangles (one for each child node)
 - this is repeated until all the nodes are represented

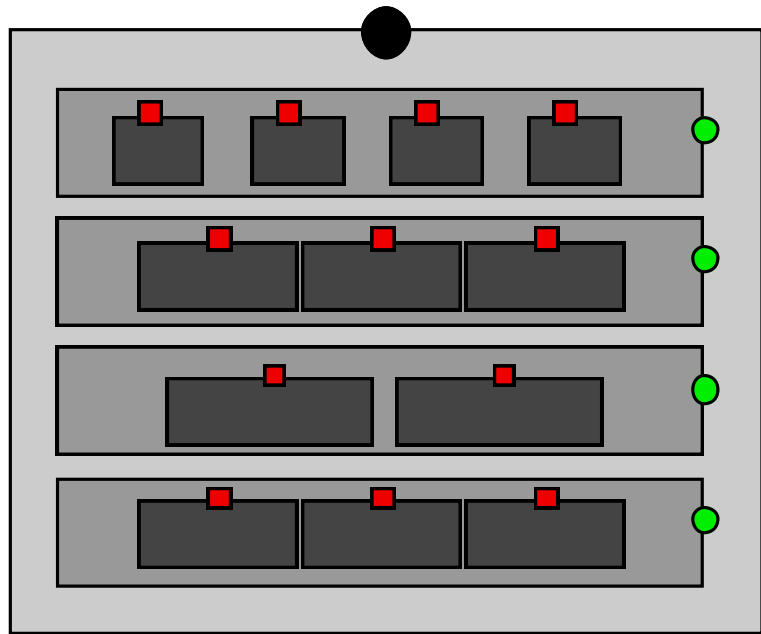


The construction of a Tree Map (Spence, 2007)



Tree

Tree Map

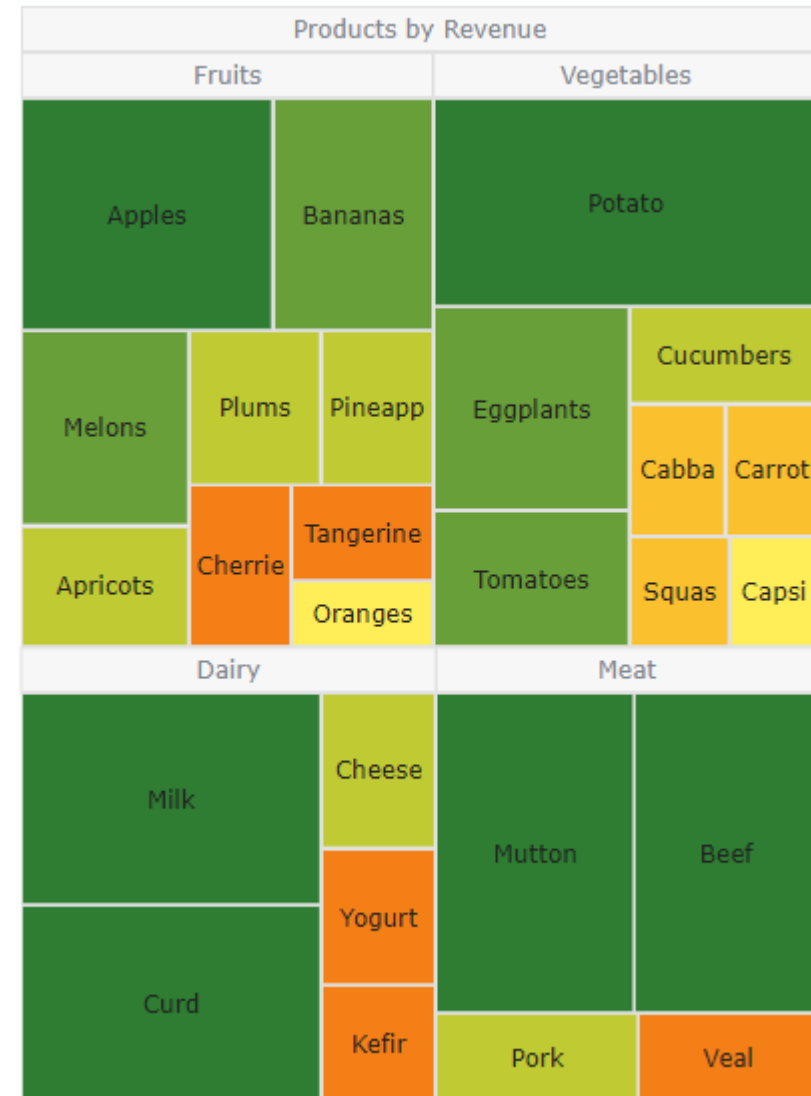


The 'slice-and-dice' construction of a Tree Map to obtain leaf nodes represented by rectangles more suited to the inclusion of text and images (Spence, 2007)

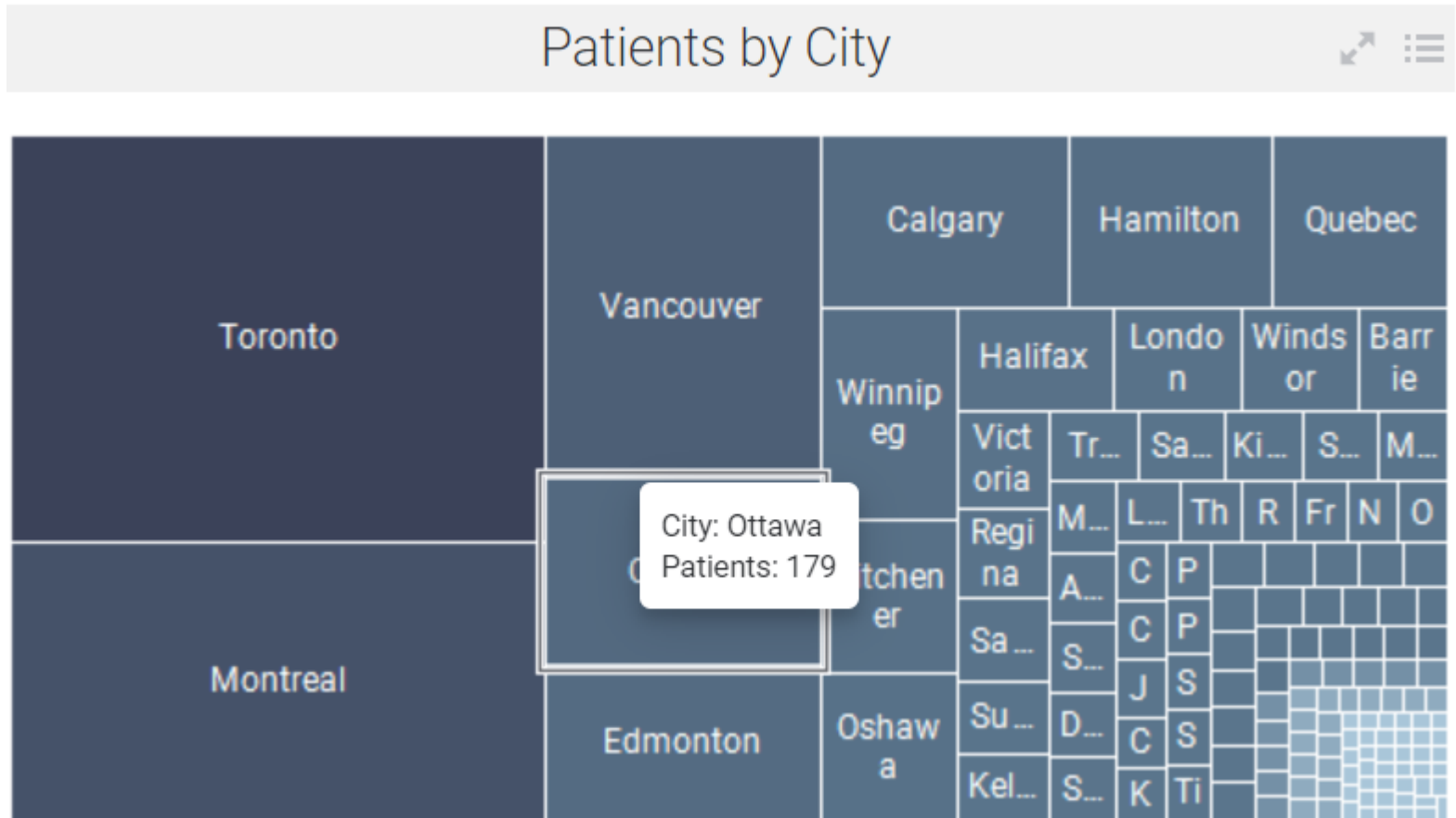
<https://www.youtube.com/watch?v=S1yKN9bvhiA>

Main advantages of Treemaps:

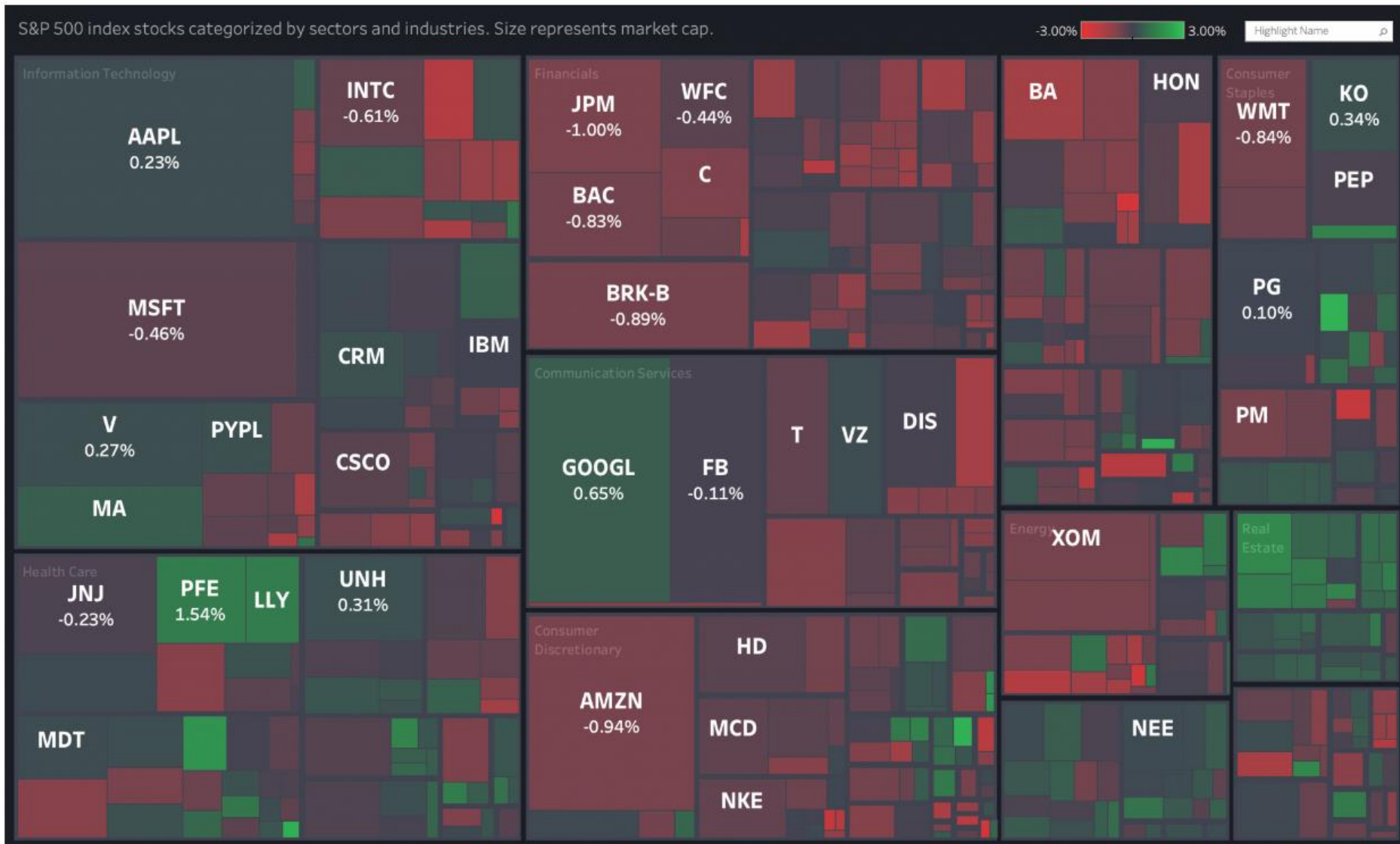
- Allow identifying the relationship between two elements in a hierarchy
- optimize the use of space
- accurately display multiple elements together
- show ratios of each part to the whole



- The treemap offers a lot of opportunities for
 - encoding by color and area
 - interaction by mouse-over and selection of further detail by mouse click



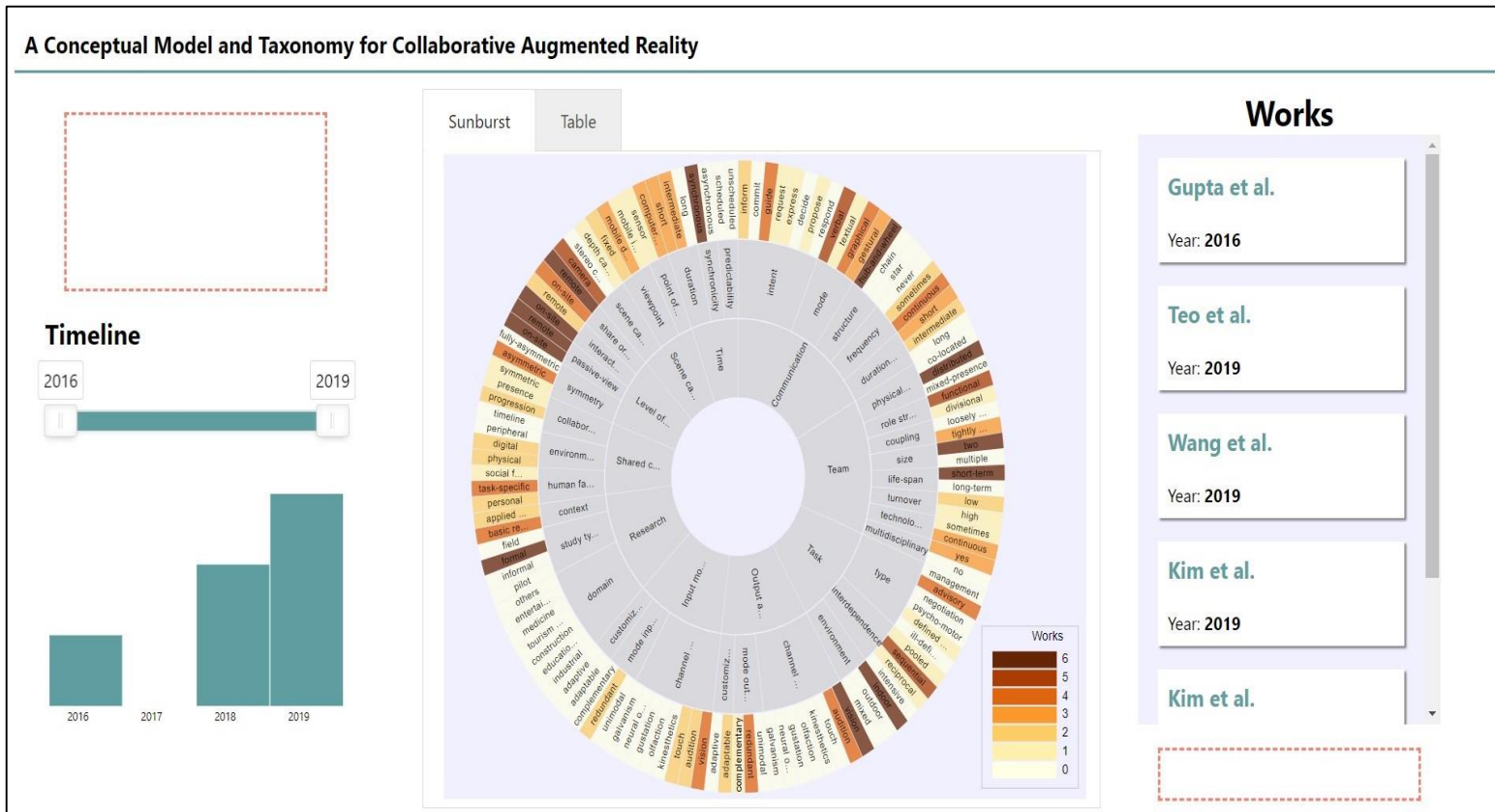
Example: Using a treemap to visualize stock markets



Status of companies within a number of sectors

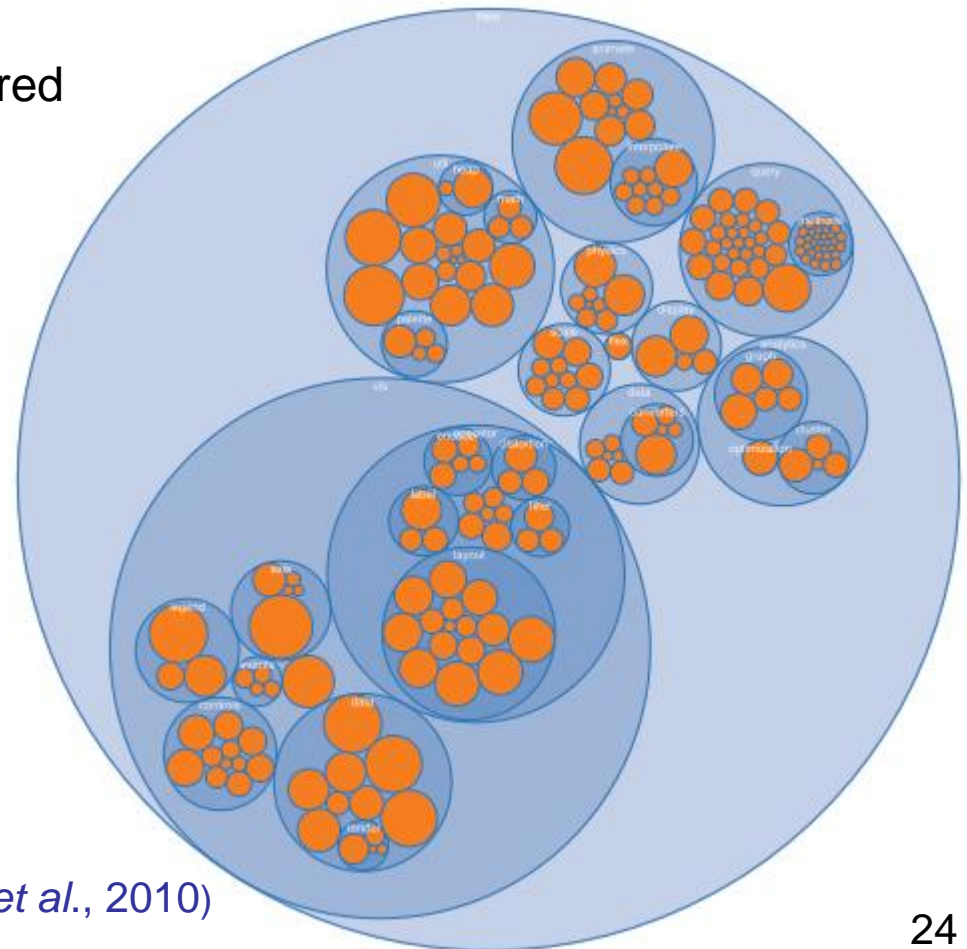
<https://canonicalized.com/tableau-financial-analytics/>

Example: Using a Sunburst to visualize a taxonomy of papers



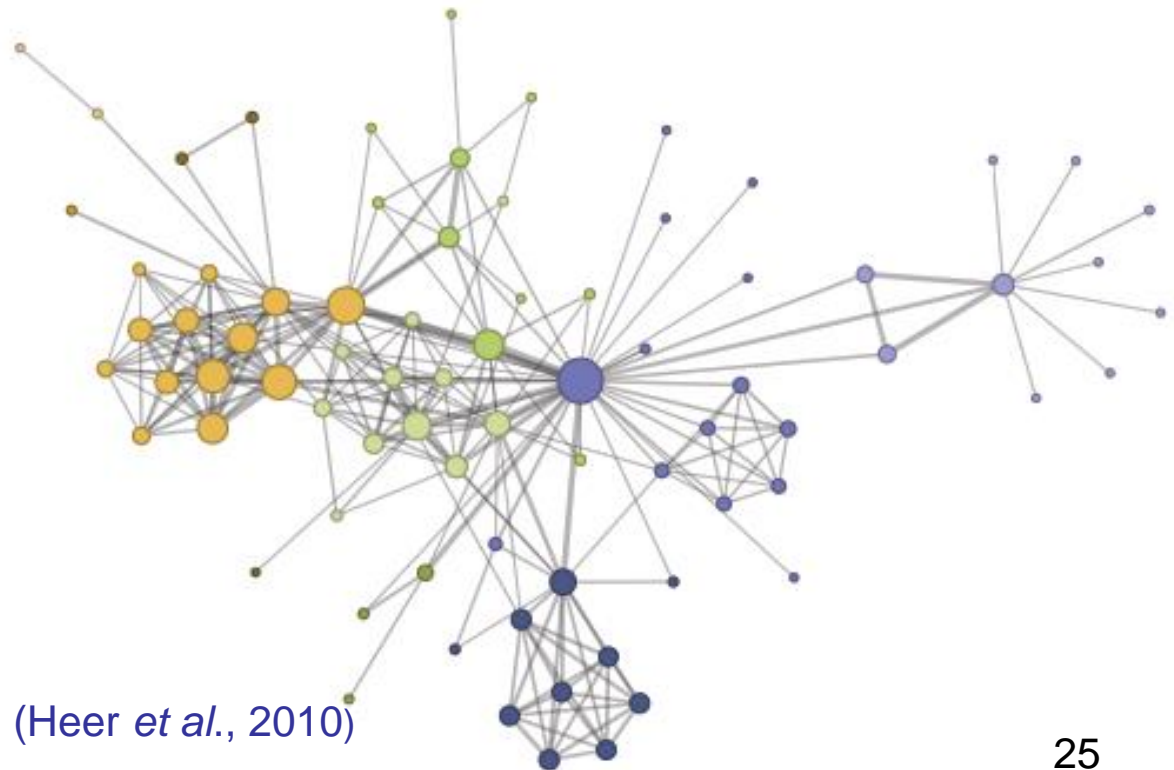
https://tiagodavi70.github.io/survey_viewer/overview.html

- The **nested circles** layout is a different sort of enclosure
- It does not use space as efficiently as a treemap, but it effectively reveals the hierarchy
- Node sizes can be rapidly compared using area judgments.



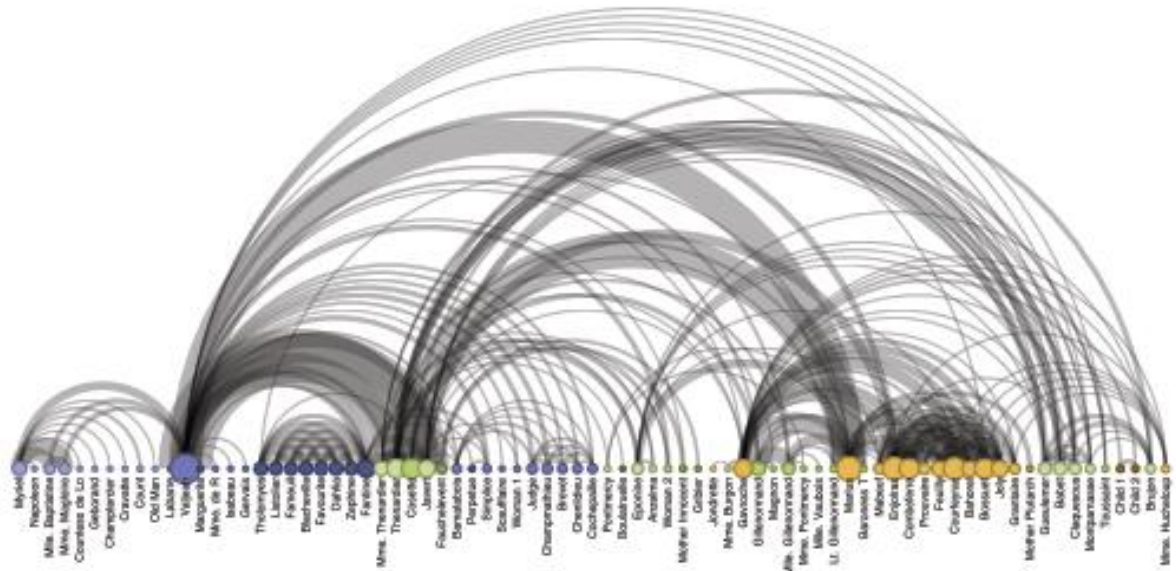
(Heer *et al.*, 2010)

- The **node-link (force directed)** layout is a common and intuitive approach to network layout; it models the graph as a physical system
- Nodes are charged particles that repel each other, and links are dampened springs that pull related nodes together

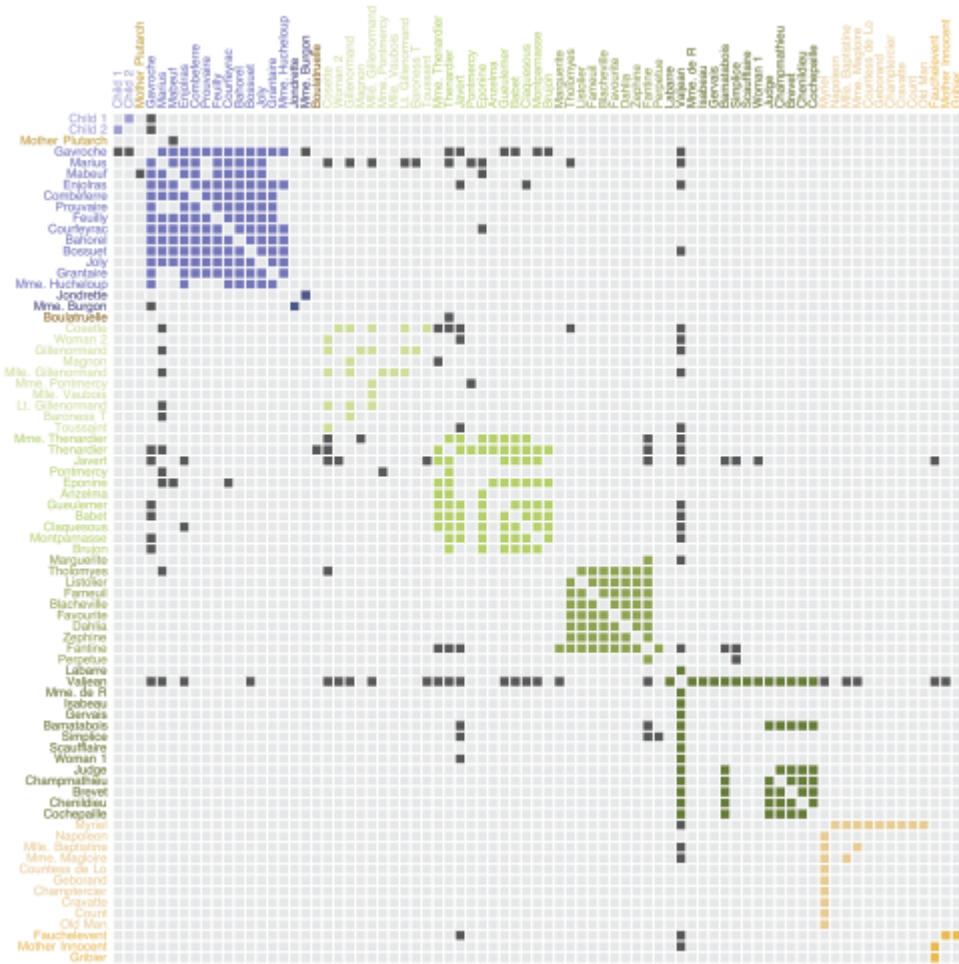


- The **arc diagrams** use a one-dimensional layout of nodes, with circular arcs to represent links
- May not convey the overall structure of the graph as effectively as a two-dimensional layout, with a good ordering of nodes it is easy to identify cliques and bridges
- , Multivariate data can easily be displayed alongside nodes
- Seriation is the problem of sorting the nodes in a manner that reveals underlying cluster structure is formally called seriation

(Heer *et al.*, 2010)

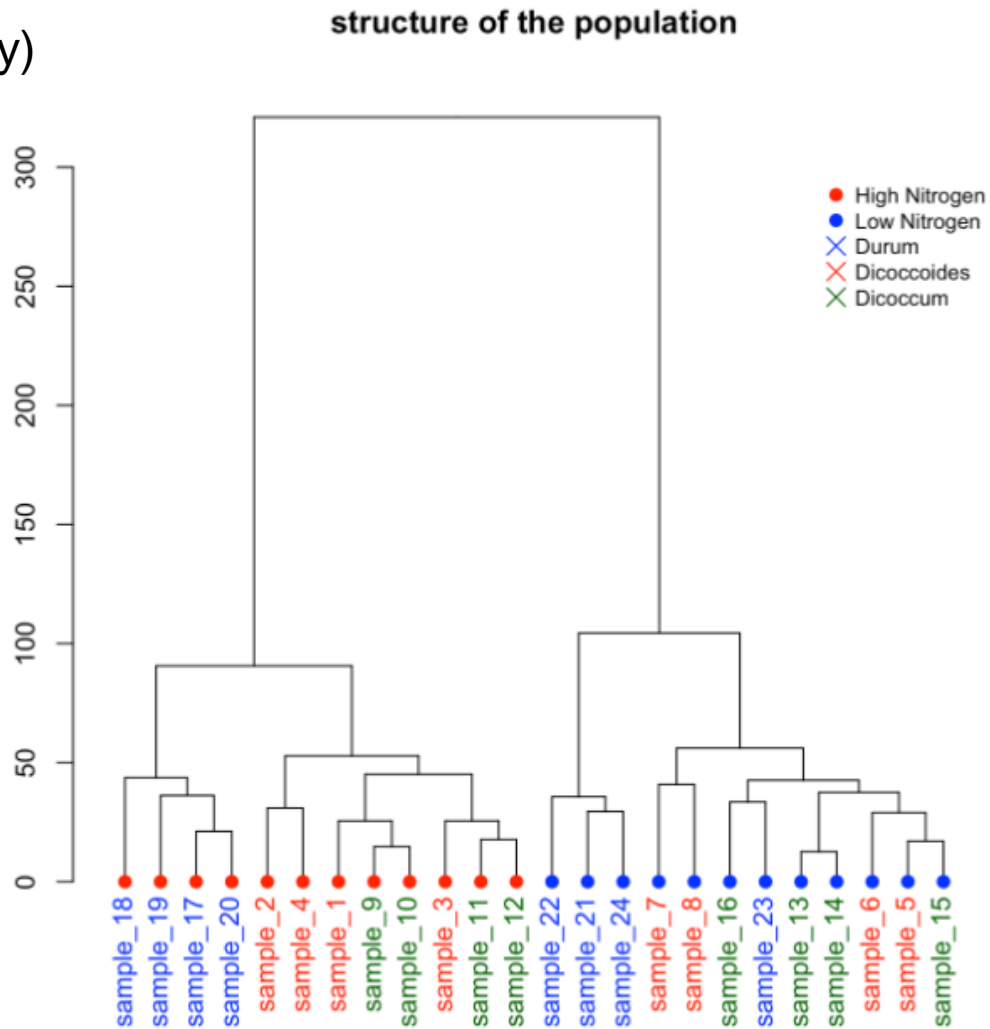


- The **matrix views** represent the adjacency matrix of a graph
- Using color or saturation instead of text allows values associated with the links to be perceived more rapidly
- , The seriation problem also applies



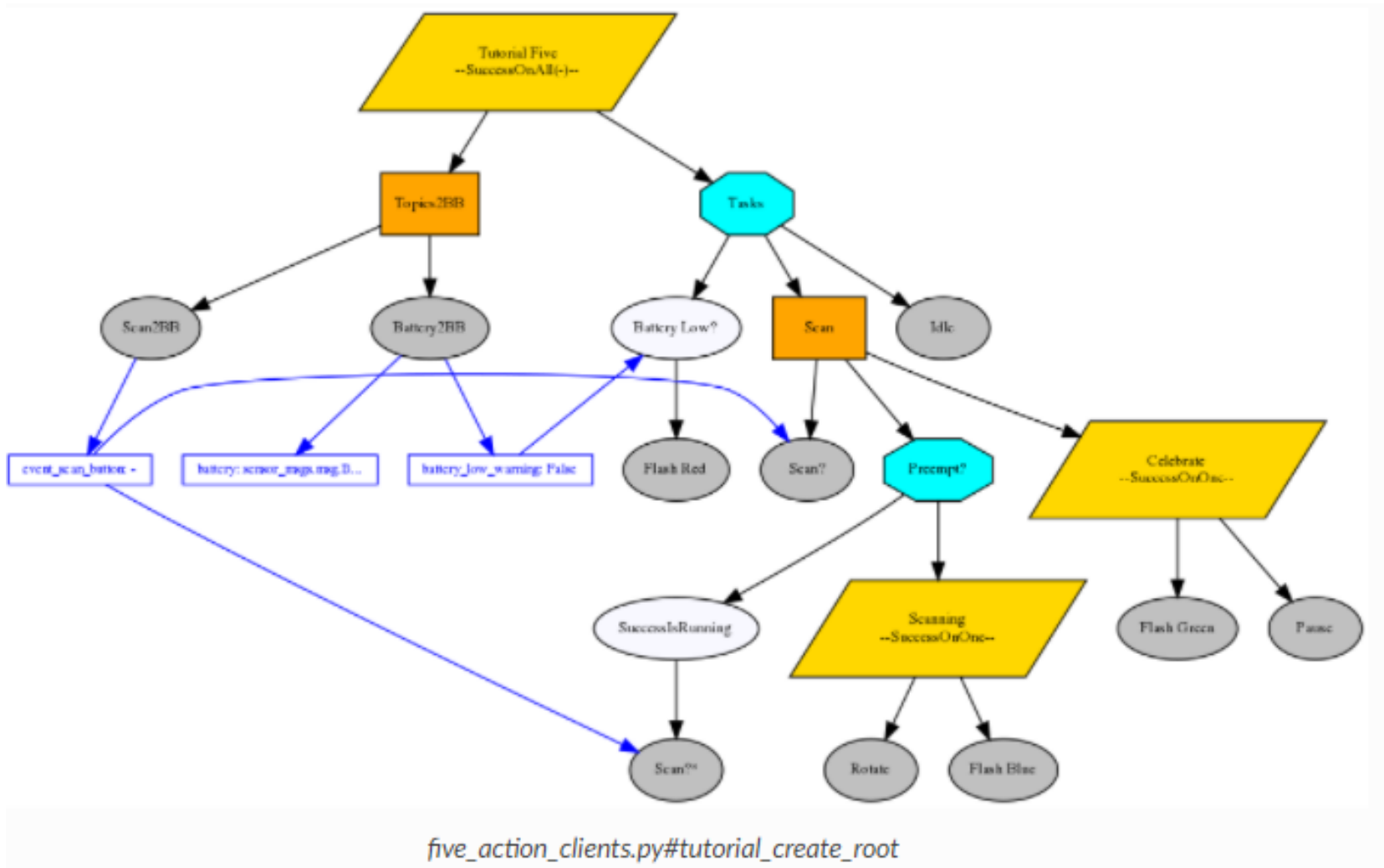
(Heer et al., 2010)

- The **dendrogram** is a branching diagram that represents the relationships of similarity among a group of entities
- It is used to visualize the result of clustering (group samples by similarity)



[Most basic dendrogram for clustering with R – the R Graph Gallery](#)

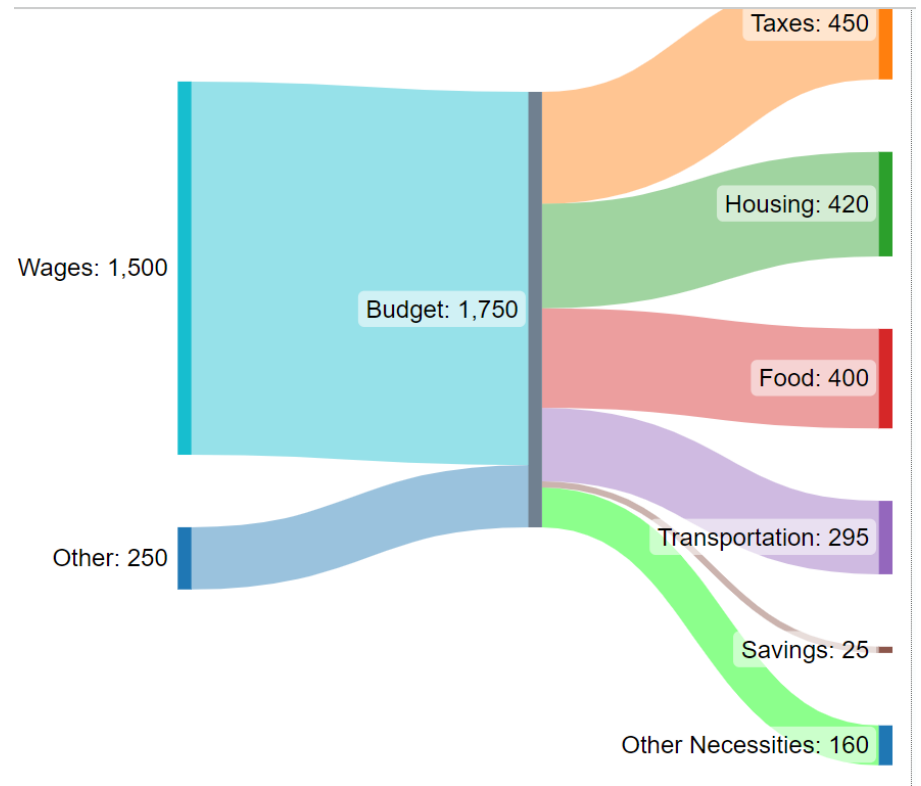
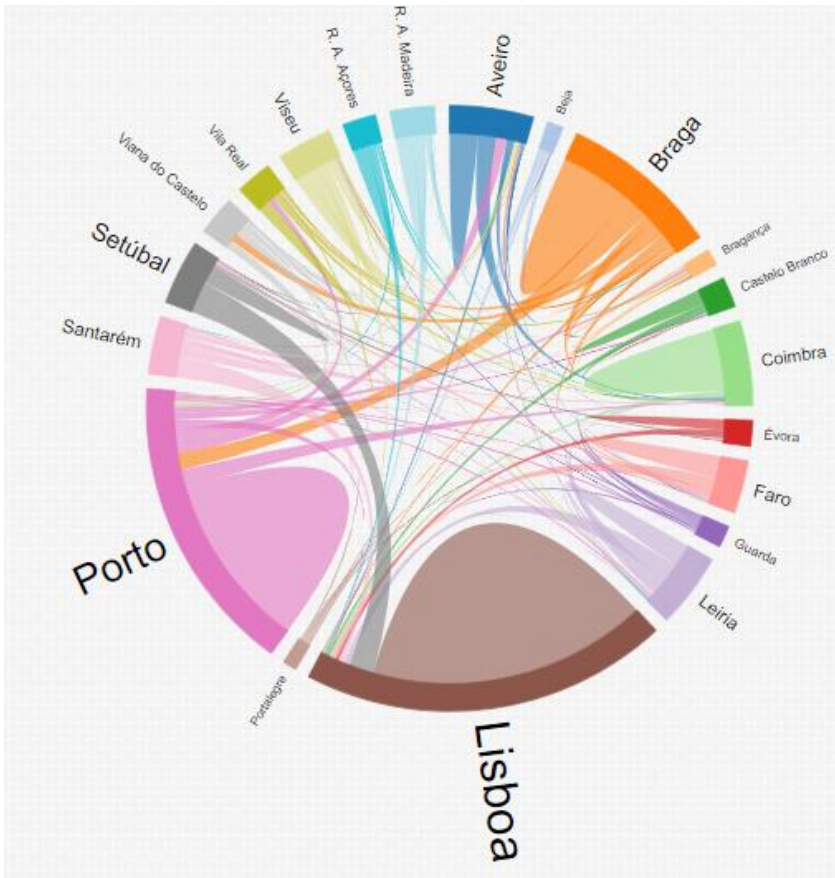
A graph visualization: The ROS Computation Graph



- “ **many more ... visualization exist ...** Emerging domains such as bioinformatics and text visualization are driving researchers and designers to continually formulate new and creative representations ... the DNA underlying all visualizations remains the same: the principled mapping of data variables to visual features such as position, size, shape and color...” (Heer *et al.*, 2010)

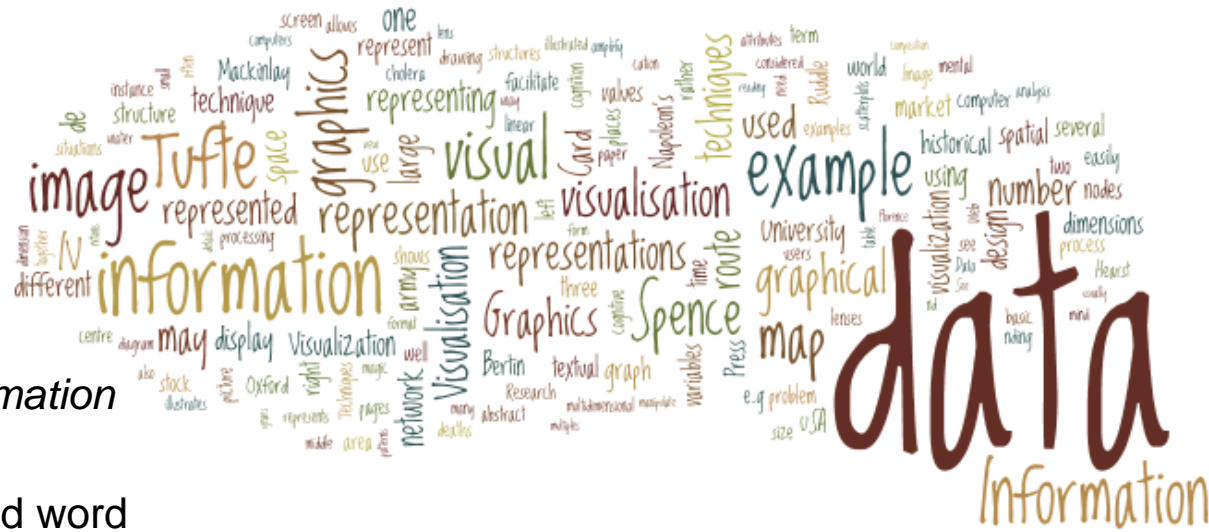
Sankey diagrams

- Useful to convey the idea of flow



Word Cloud: simple representation of text

- Used to visualize free form text or tags
- After preprocessing the text the number of occurrences of each word is shown with font size or color



R. Mazza, *Introduction to Information Visualization*, 2009 (chap.1):

“**Data**” was the most often used word

[Creating Emordle: Animating Word Cloud for Emotion Expression | IEEE TVCG2024](#)

Main Bibliography

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- <http://www.wikiviz.org/wiki/Main>
- Books with * and other interesting books at:

<https://learning.oreilly.com/playlists/74bfec5e-4346-48ff-82b4-657fda6922b6> 35