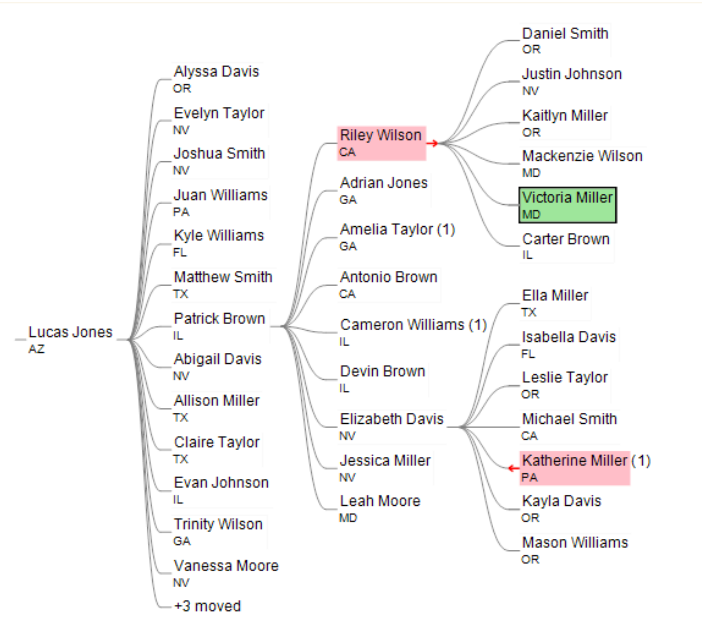
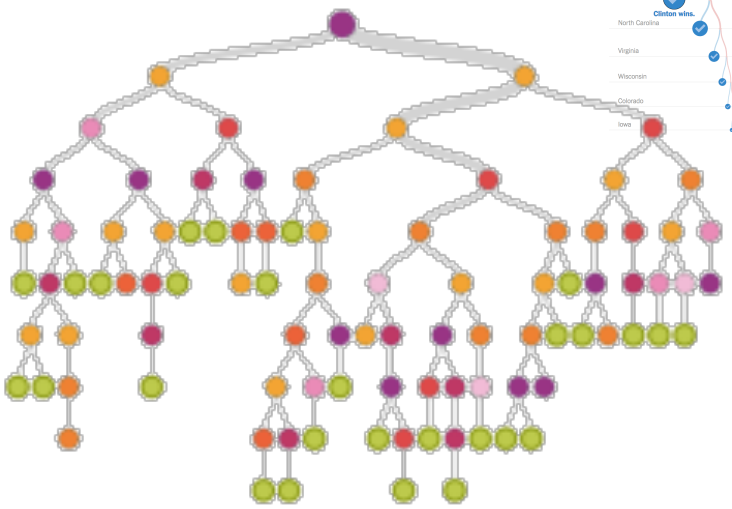
Module #7c:
Tree Visualization

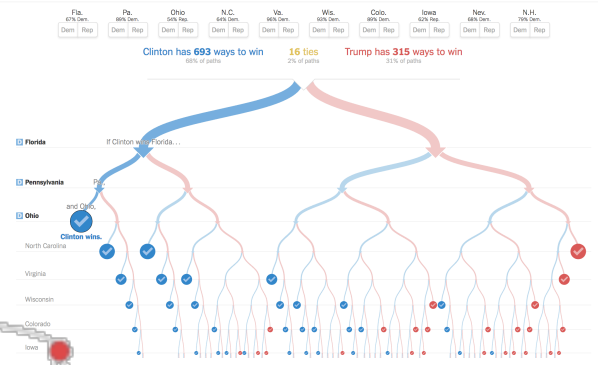
Tree Layout

- Similar to graph layouts, many layout algorithms have been proposed for trees.

- The most population approach is the classic layout



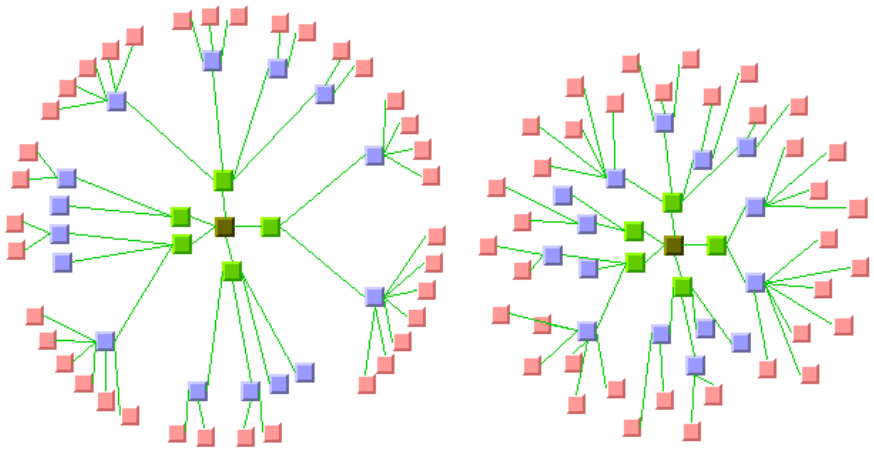




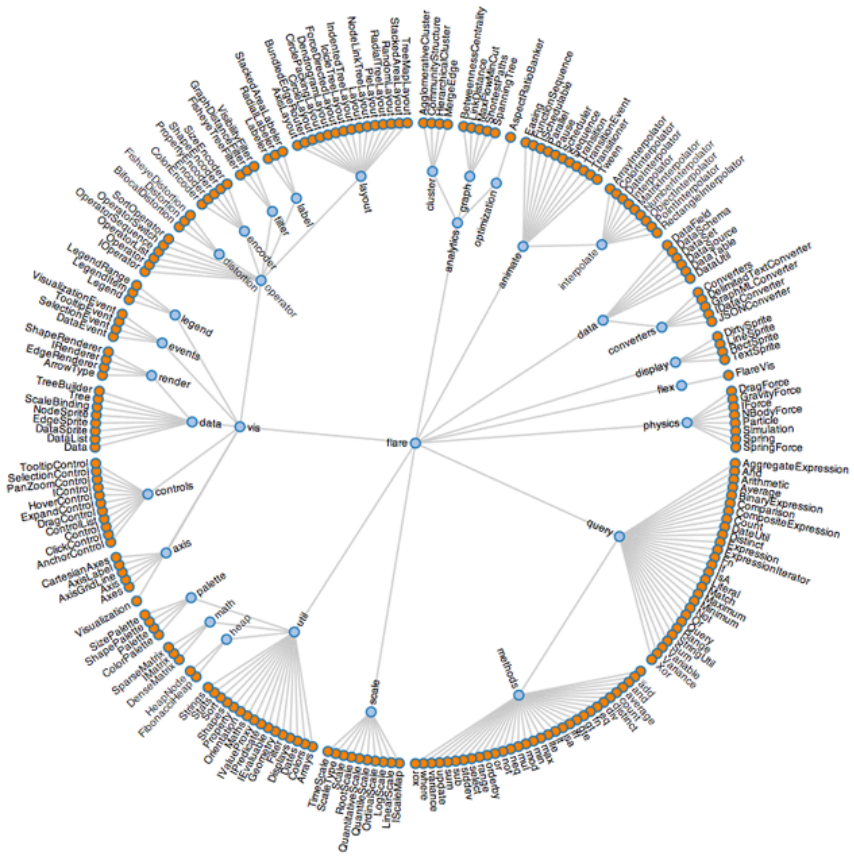
Radial Tree layout Algorithms

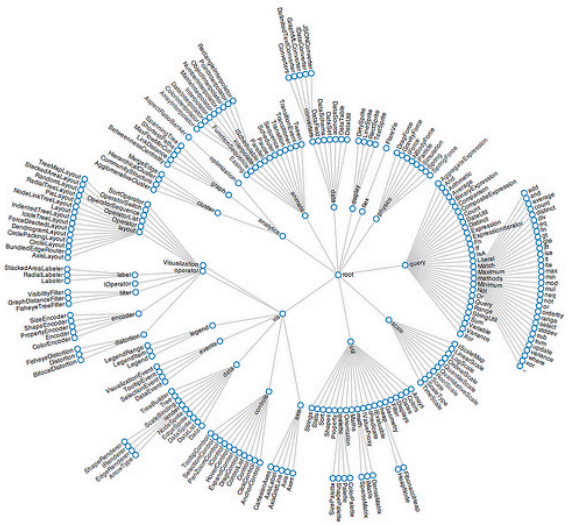
- **Radial layout algorithm:** places the root in the middle of co-centric circles and distributes the children of a sub-tree into circular shape according to their depth in the tree recursively.

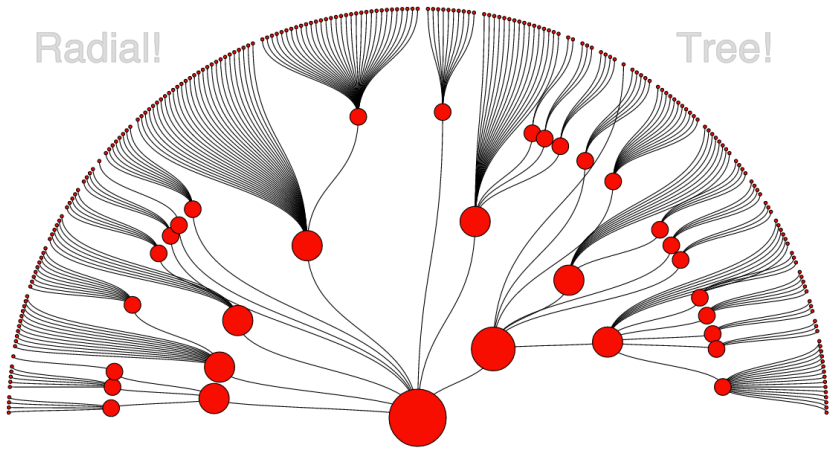
- Pros:
  - The radial layout uses space in more efficient way than the classical method.
- Cons:
  - But it lacks the understandability of classical tree layouts, e.g. it is difficult to find the root of the tree



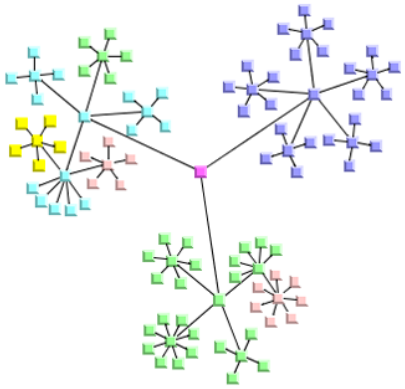
Radial Tree layout Algorithms



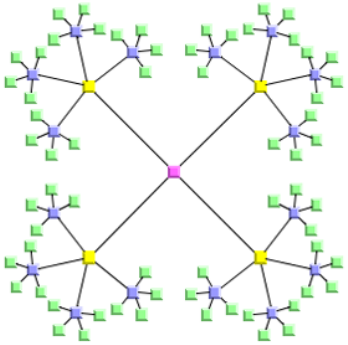




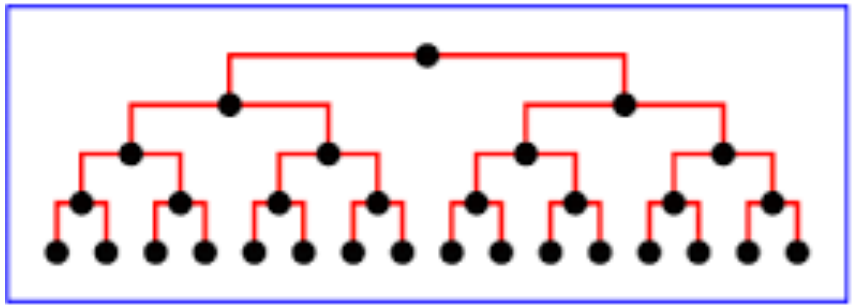
Tree Layout

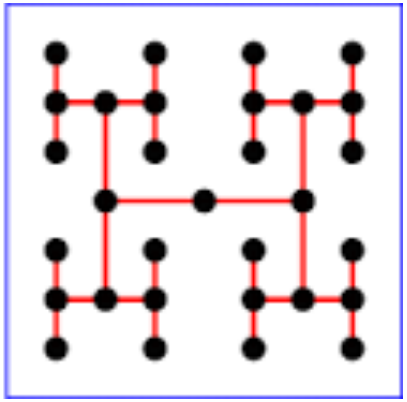


- **Balloon layout**
  - sibling sub-trees are drawn in a circle centered at their parents.



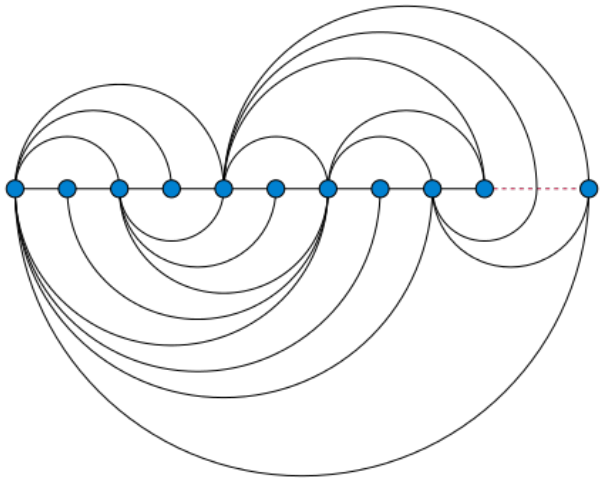
- **H-Tree layout**
  - produces a classical layout for binary trees and works perfectly for balanced trees.
  - Hard to identify the root position



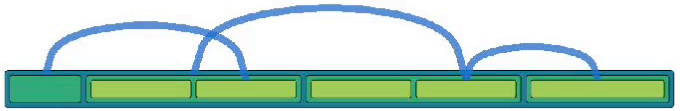


Tree Layout

- Arc tree:
  - Inspired by the arc diagrams.
  - Vertices are placed on a line, size depends on the level in the three.
  - Edges may be drawn as semicircles above or below the line.



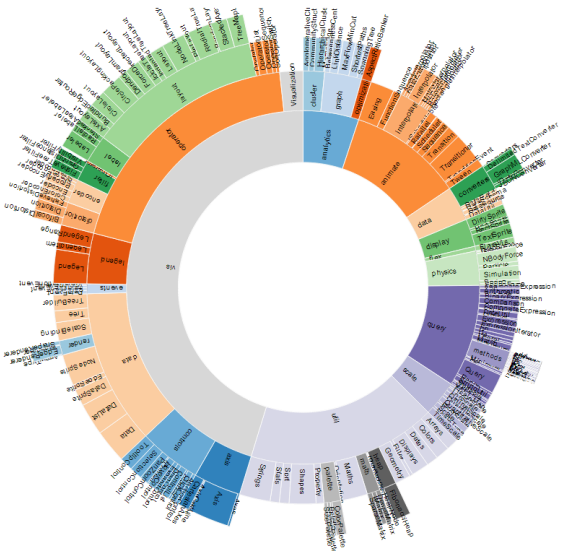
Arc Tree Visualization



Space-Filling Techniques

- **Space-Division layout**: the parent-child relation is depicted implicitly by attaching the children to their parent

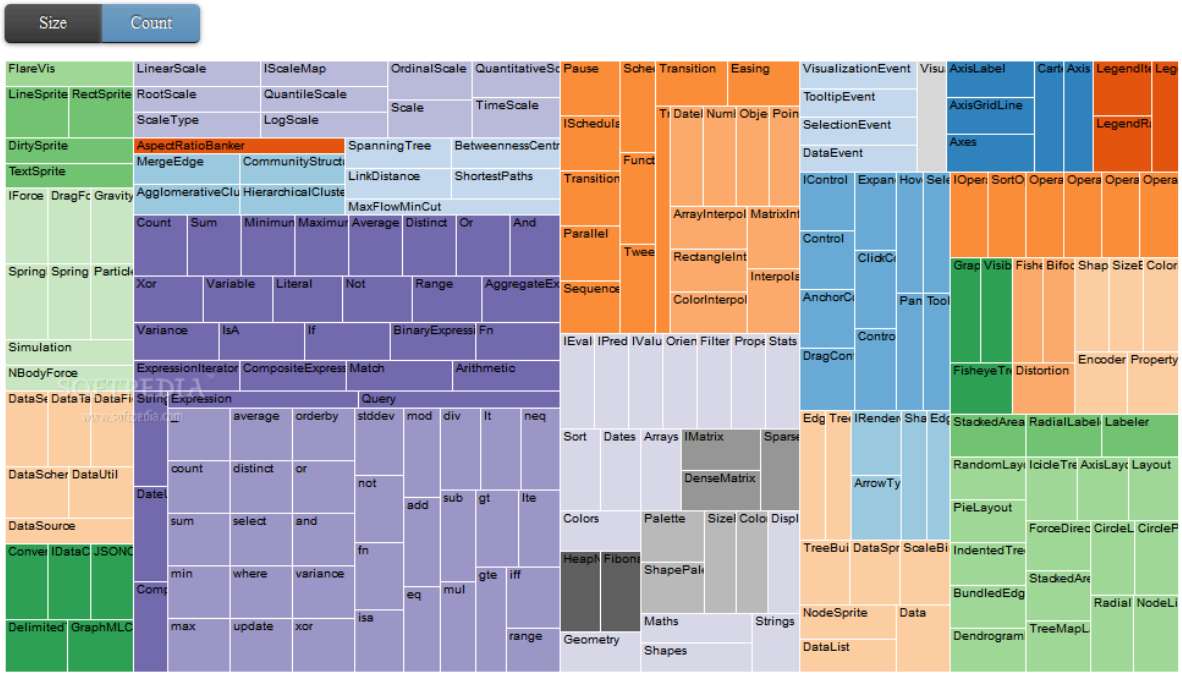
- **Space-Nested** layouts the child-parent relationship is drawn using nested boxes.



Sunburst Technique

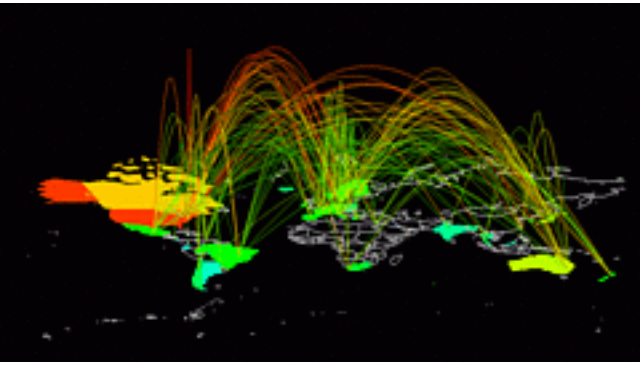
Space-Nested Layouts

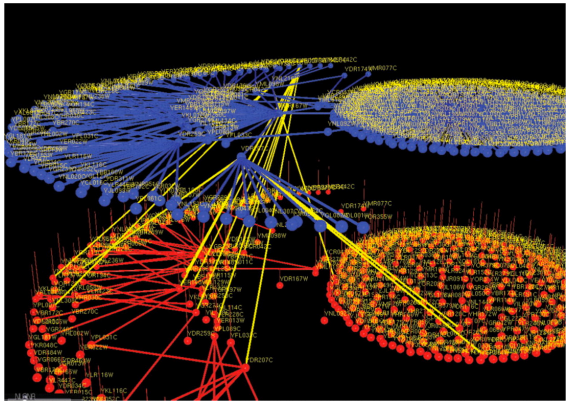
- **Space-Nested layouts:** place the children within their parent node. A good common example is the Treemap.

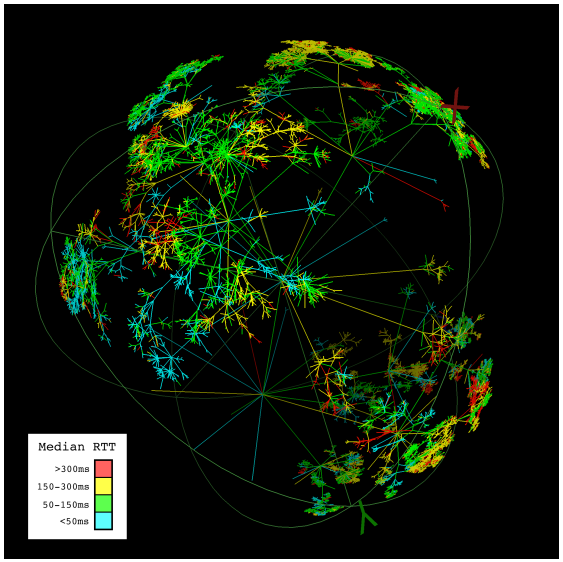


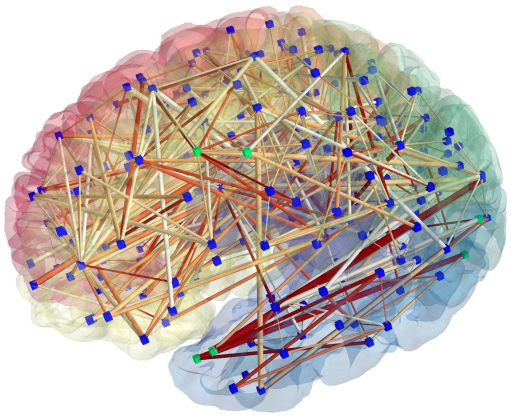
3D Layout

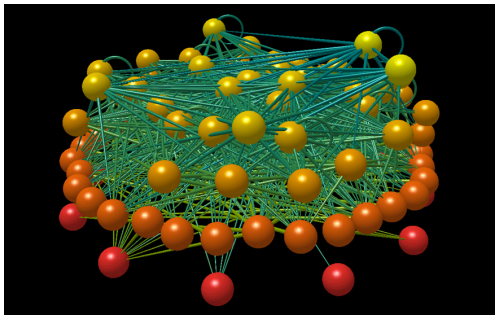
- Most of the layout techniques can be extended to 3D
- Not widely used.





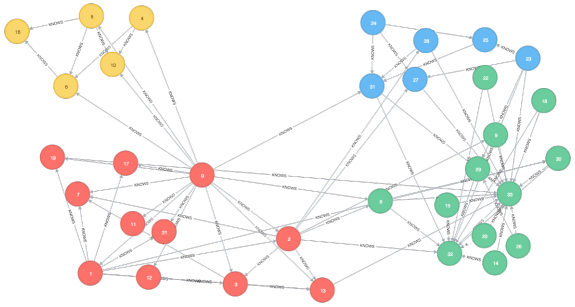


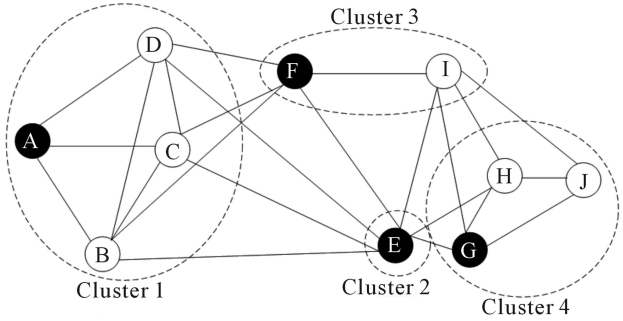




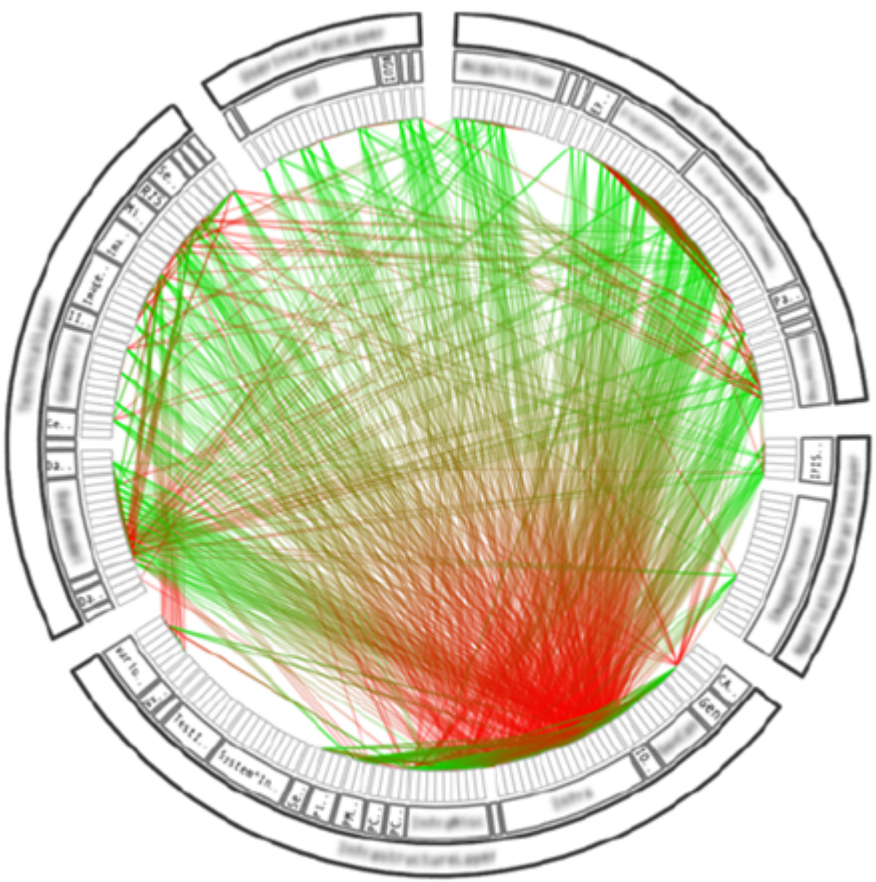
Nodes and Edges Clustering

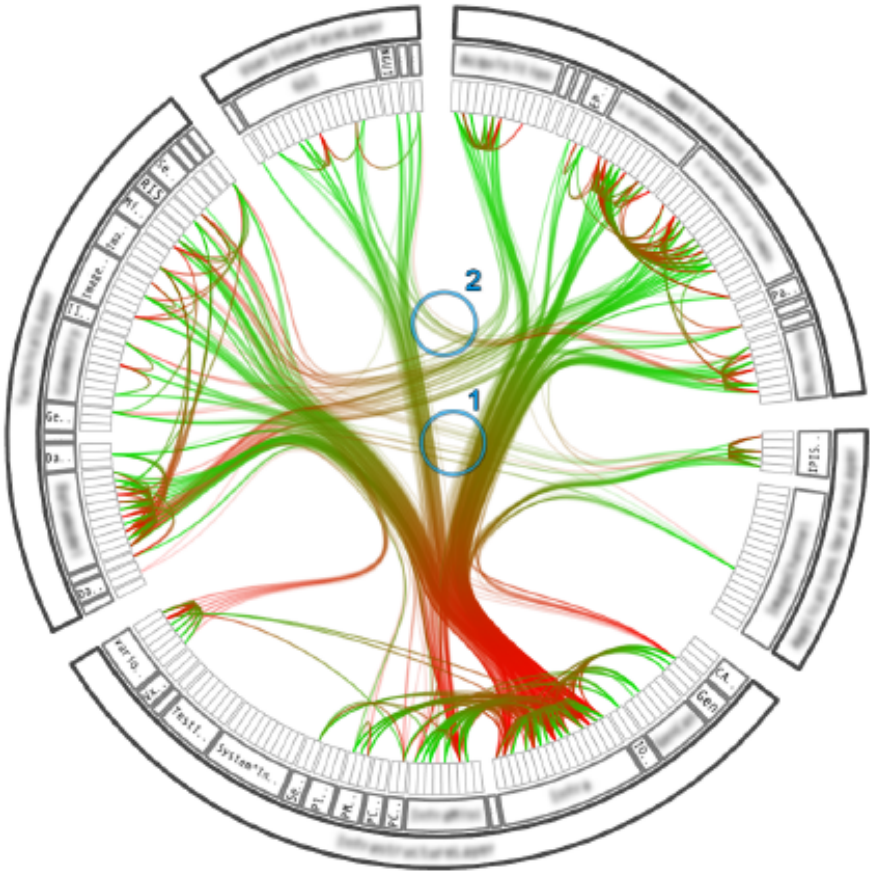
- Nodes and edges can be clustered to enhance the visualization
  - **Natural clustering:** structural information among the graph nodes is used to find a pattern of nodes having the same common criterion.
  - **Content-based clustering:** the semantic meaning of the relations among the graph nodes is taken into account
  - **Edge clustering**: bundling the relations' edges to reduce visual clutter





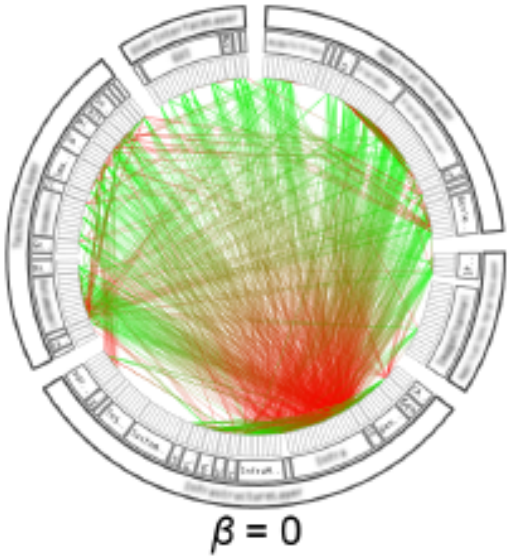
Relations within a Radial Layout



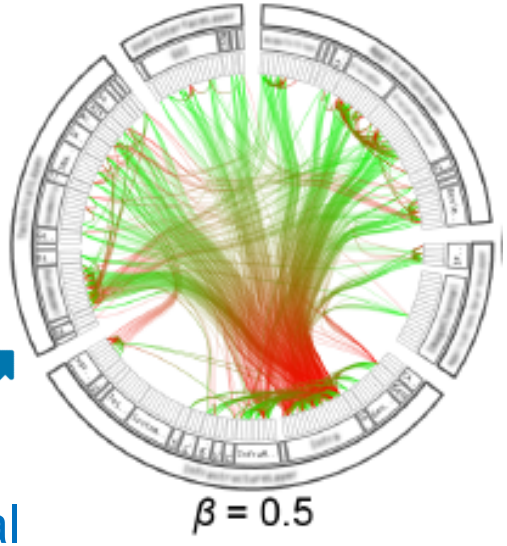


Holten D, “Hierarchical edge bundles: visualization of adjacency relations in hierarchical data”, TVCG 2006.

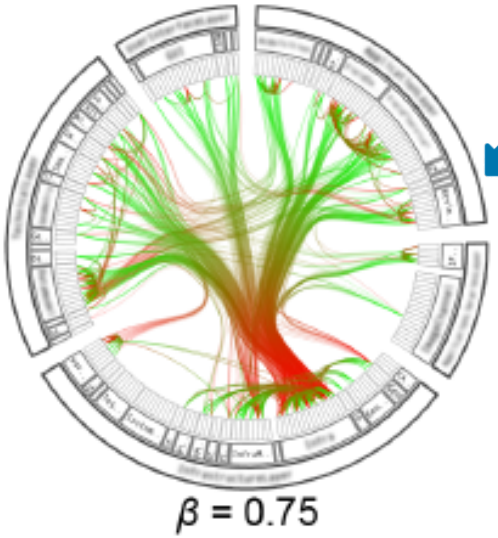
Bundling Strength



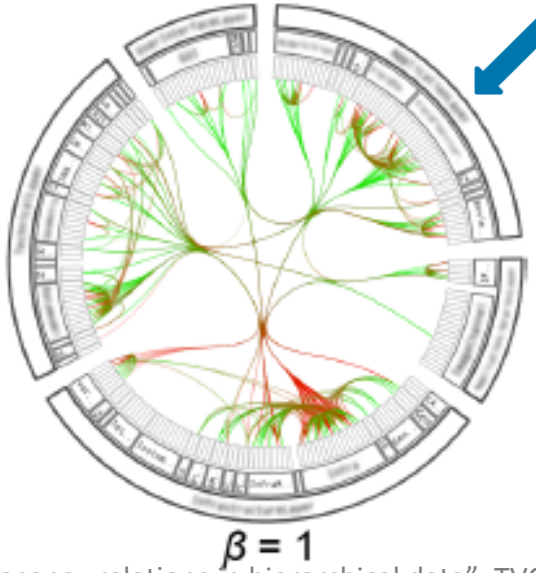
Shows node-to-node connectivity



Bundles reduce visual clutter

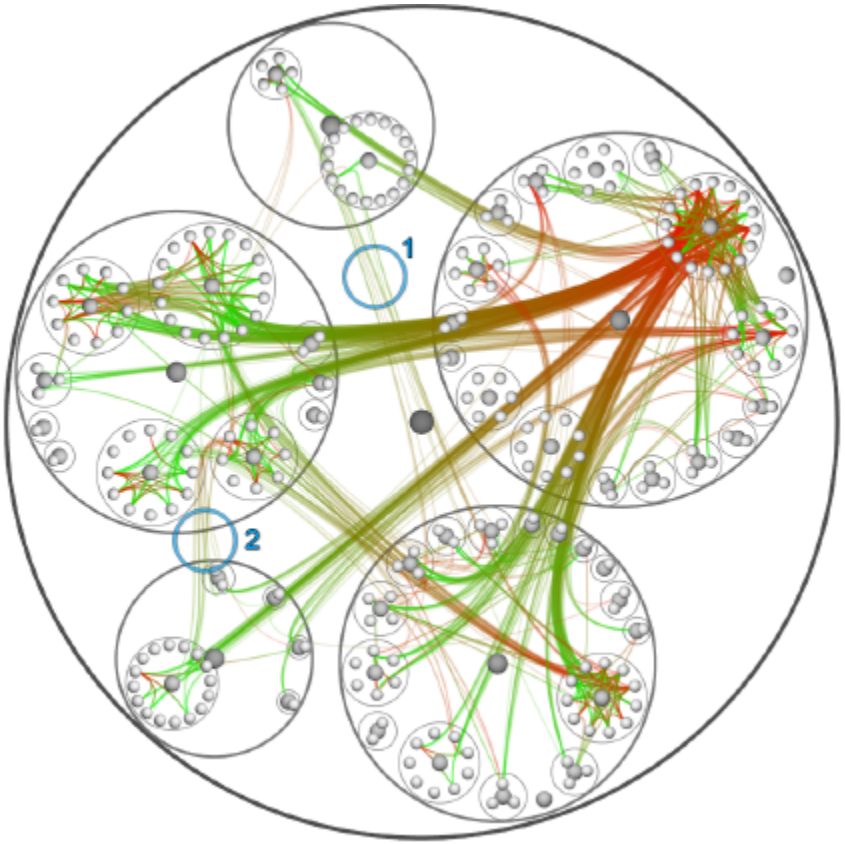


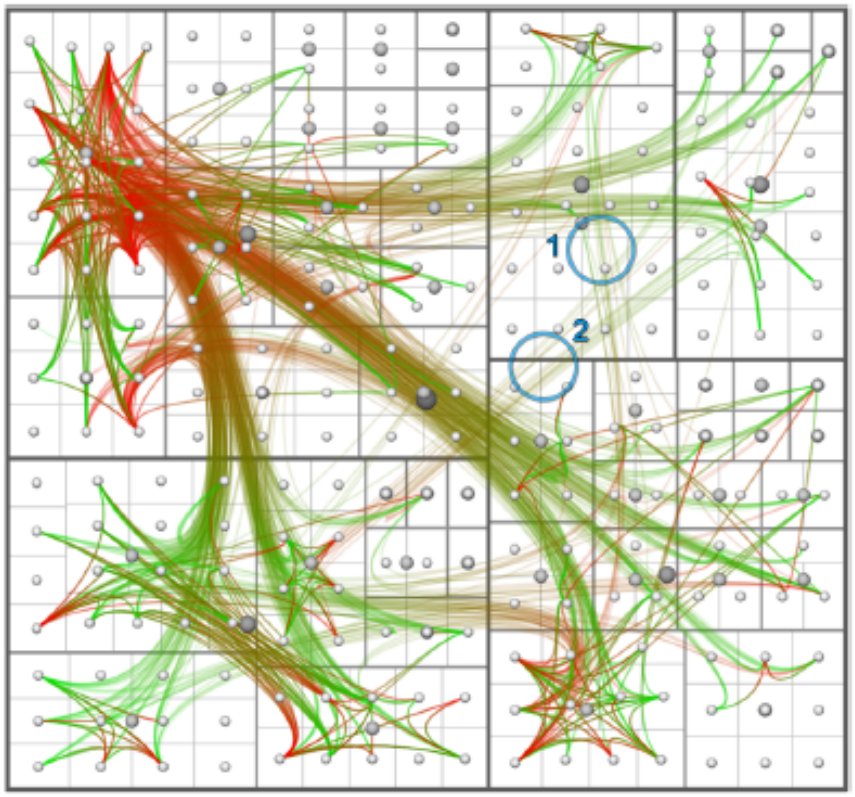
Shows implicit relations between parents



Holten D, "Hierarchical edge bundles: visualization of adjacency relations in hierarchical data", TVCG 2006.

Other Hierarchical Representations?





- Works for radial layout, balloon layout and treemaps

Holten D, "Hierarchical edge bundles: visualization of adjacency relations in hierarchical data", TVCG 2006.

Interaction Techniques

- Interaction with the graphical interface and visualization is essential in for graph and tree visualizations
  - **Selecting:** giving the user the ability to highlight and process specific objects.
  - **Abstracting/Elaborating:** changing the level of detail of the representation scheme. This allows users to get different insights into the data.
  - **Reconfiguring:** giving the user the ability to change the layouts for the same representation scheme, such as sorting the graph nodes based on a specific criteria.
  - **Encoding:** switching between different layout methods, such as converting the node-link diagram into a sunburst layout.
  - **Exploring:** this is related to giving the user the ability to change the view point of the graph layout. Zooming and panning are examples of this category.
  - **Filtering:** removing unnecessary detail and displaying the remaining items in a more visible fashion.
  - **Connecting:** giving users the ability to highlight the paths between relevant objects and the focus object.

Tarawneh et al. “A General Introduction To Graph Visualization Techniques

Conclusion

- Define hierarchical data and related terms
- List example tasks for hierarchical and network data
- Understand approaches to draw 2D trees
- Describe treemap, SunBurst, and other techniques

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