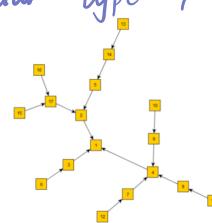


Trees

or called hierarchies

a particular type of graph



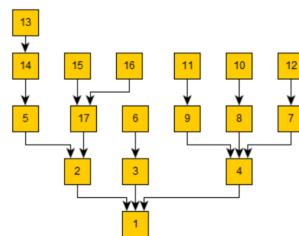
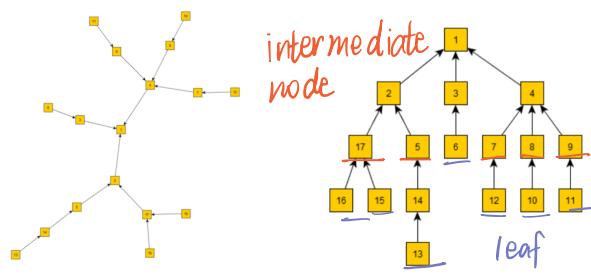
Any two nodes are connected by only one path

Every node has one unique parent

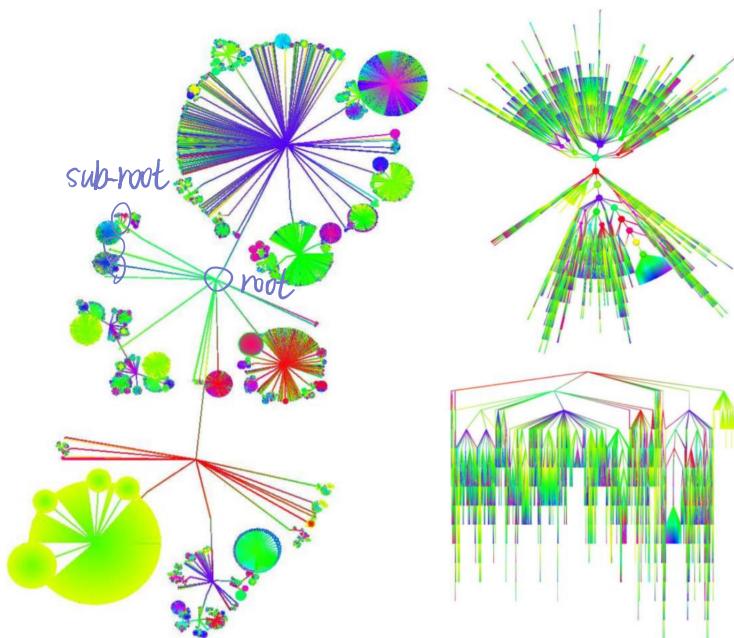
Connected: a path between all pairs of nodes

The number of edges is one less than the number of nodes

Directed or undirected



Bubble trees



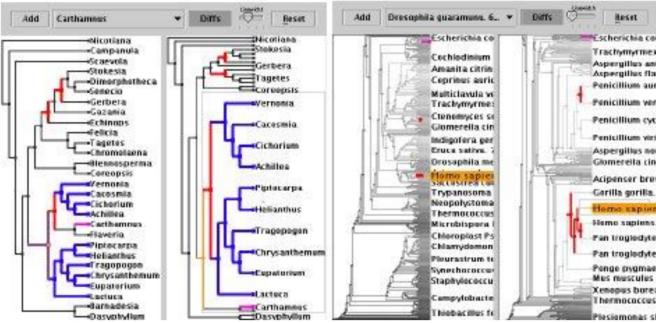
maximising angular resolution between each various level identifies symmetric sub-trees

TreeJuxtaposer

Interactive tree comparisons

Choose areas to stretch, and areas to compress

"We have presented a system that allows interaction with and detailed structural comparisons between trees of over 100,000 nodes each, and browsing single trees of half a million nodes"



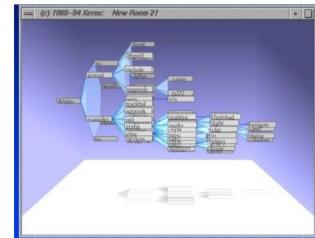
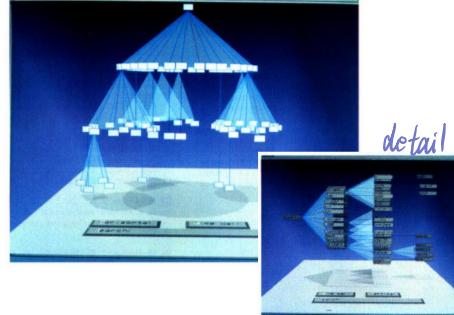
Cone Trees

3D extension of typical tree visualisations

Tree levels are arranged on circular 'disks'

Animations bring nodes of interest to the front (by spinning the disks)

Up to 10 levels, 1000 nodes



Tree Maps

Space-filling representation

Hierarchical order shown by rectangle containment

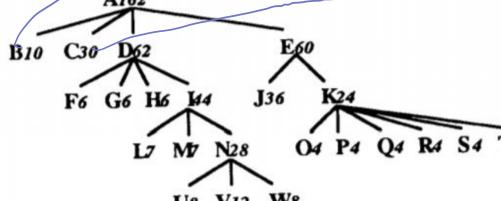


Figure 2. Tree Diagram

Here, numbers are proportional to some sort size

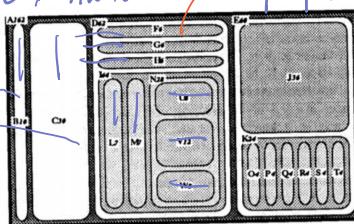


Figure 4. Nested Tree-Map

nested tree map

1. vertically → horizontally
2. chop up the space
3. allocate proportional size

only show leaf nodes

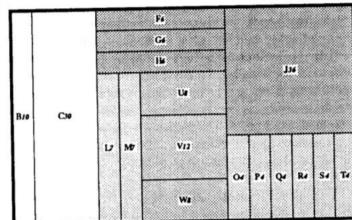
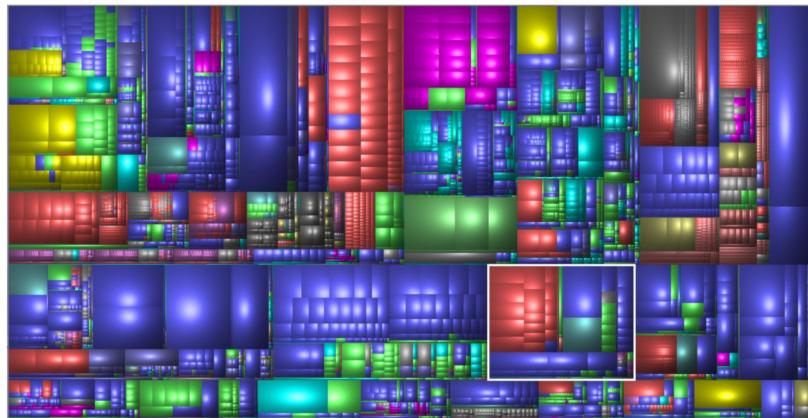


Figure 5. Tree-Map

Cushion Tree Maps



WinDirStat (Win) Disk Inventory X (Mac)

File hierarchies on a disk hard drive

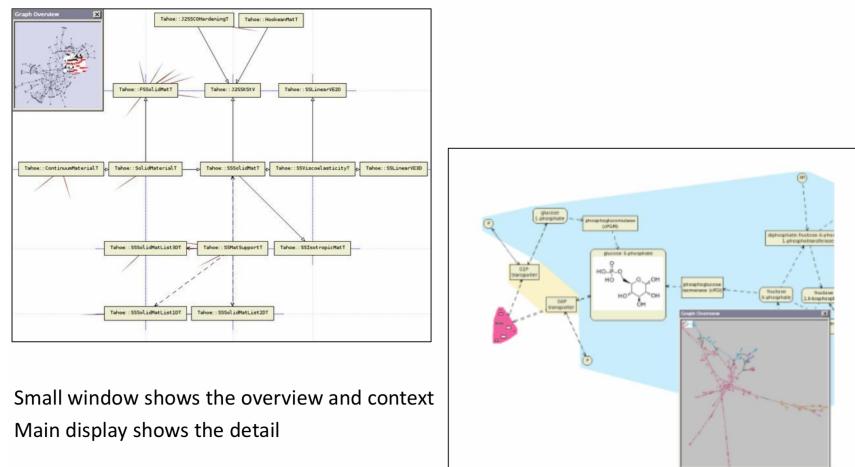
Colours: different file types (.pdf, .docx etc.)

Graph Visualisation

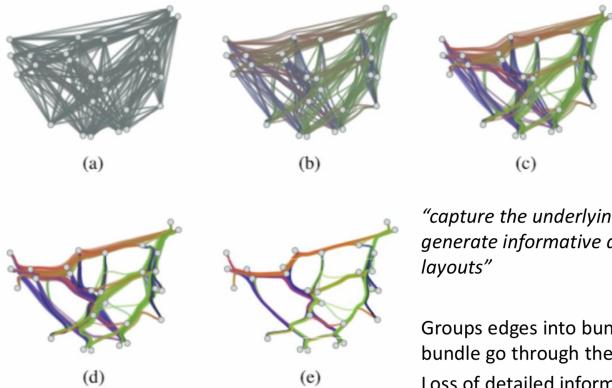
Many [interactive techniques](#) for interaction with graphs are designed to address the problem of exploring very large graphs

- **Overview+Detail:** T. Dwyer, et al. "Exploration of Networks using overview+detail with Constraint-based cooperative layout," in IEEE TVCG, vol. 14, no. 6, pp. 1293-1300, 2008.
 - **Edge Clustering:** W. Cui et al. "Geometry-Based Edge Clustering for Graph Visualization". In Proceedings of Information Visualization 2008.
 - **Edge Bundling:** D. Holten. "Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data." IEEE TVCG, 12(5):741-748, 2006.
 - **Dense Networks:** A. Nocaj, M. Ortmann and U. Brandes: Untangling the Hairballs of Multi-Centered, Small-World Online Social Media Networks. Journal of Graph Algorithms and Applications 19(2):595-618, 2015.

Overview+Detail



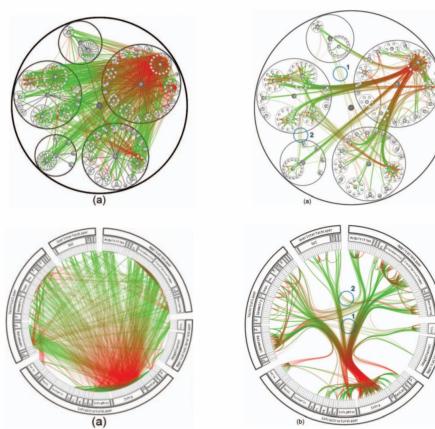
Edge Clustering



“capture the underlying edge patterns and generate informative and less cluttered layouts”

Groups edges into bundles; all edges in a bundle go through the same point
Loss of detailed information, but indicative structure shown (and details recoverable)

Edge Bundling



Particular focus on hierarchies
"quickly gaining insight in the adjacency relations present in hierarchically organized systems, aesthetically pleasing

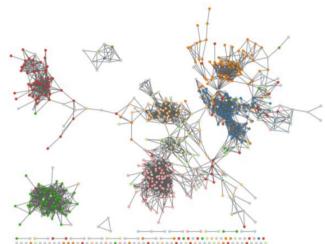
maximise white space
but not really
bind and as much white
as possible

Dense Networks



Identifying communities in social networks – finding the ‘backbone’ between strong communities

- Only keep edges that are important:
 - support short cycles (length 3)



Then use a layout algorithm on the reduced graph

- **Graphs:** abstract data structures
 - directed, undirected, connected, trees, planar
- **Graph drawings:** visual representations of graphs
 - node-link: algorithms, aesthetics
 - trees: node-link & space-filling
- **Graph visualisations:** interactive techniques for exploring graphs