Techniques
Trees and Hierarchies

Online Course
Data Visualization for Professionals

THE UNIVERSITY of EDINBURGH

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June 2020
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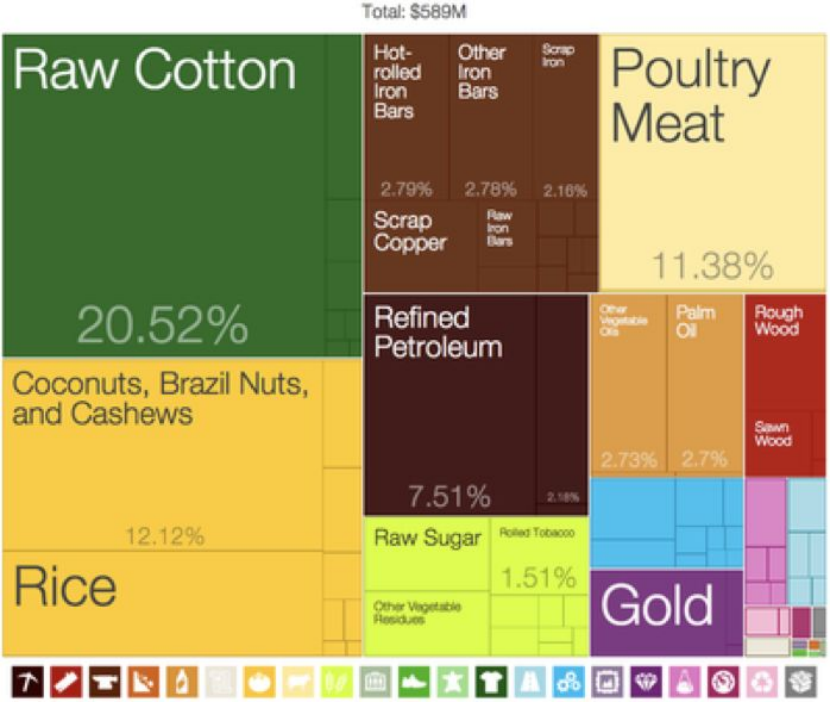
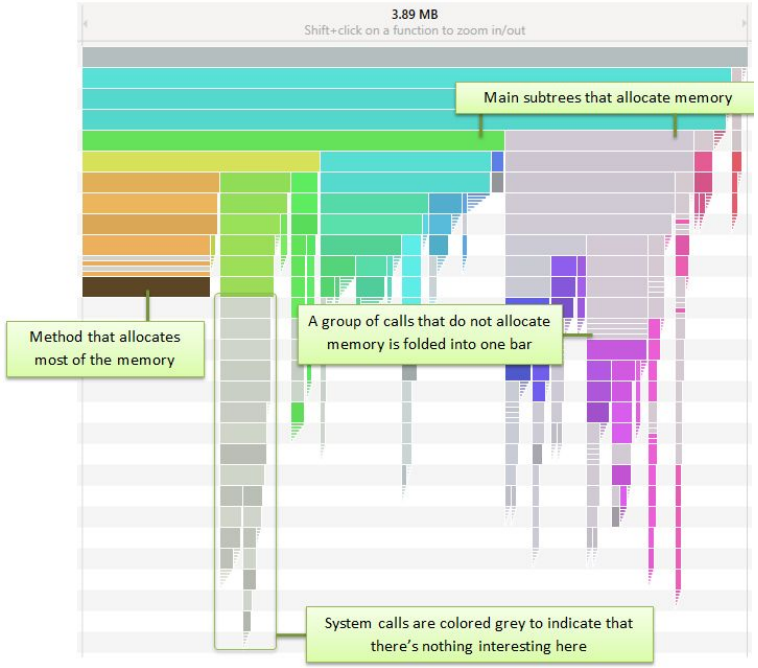
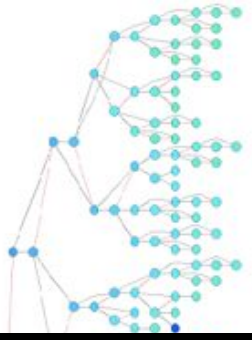
https://datavis-online.github.io

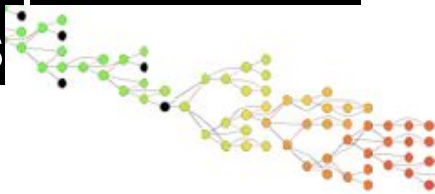
-- Not for external use --

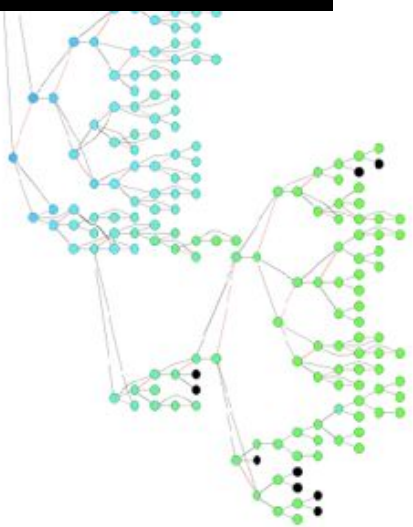




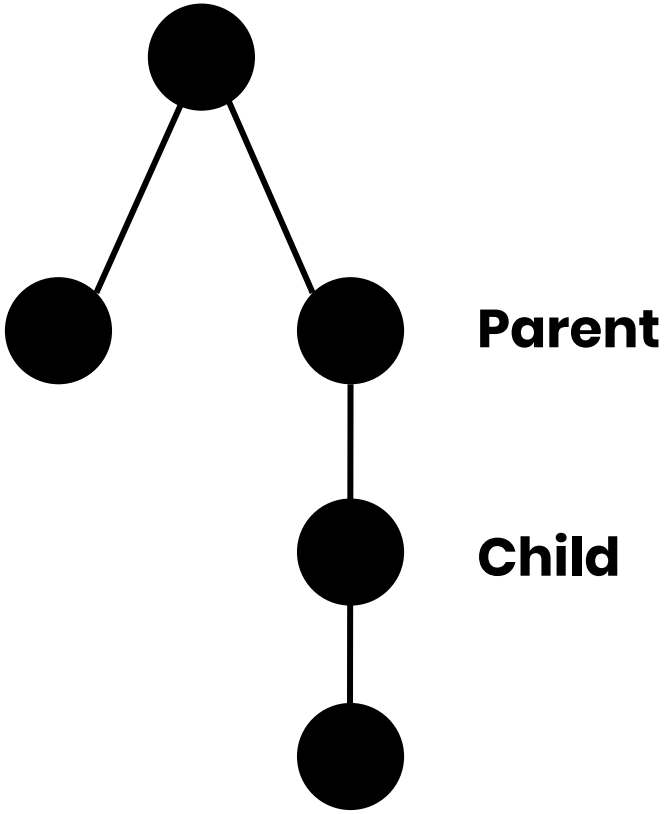


- Family trees
- Organisational hierarchies
- File systems
- Phylogenetic trees
- Processes + subprocesses
- Political entities
- Taxonomies
- …





Terminology



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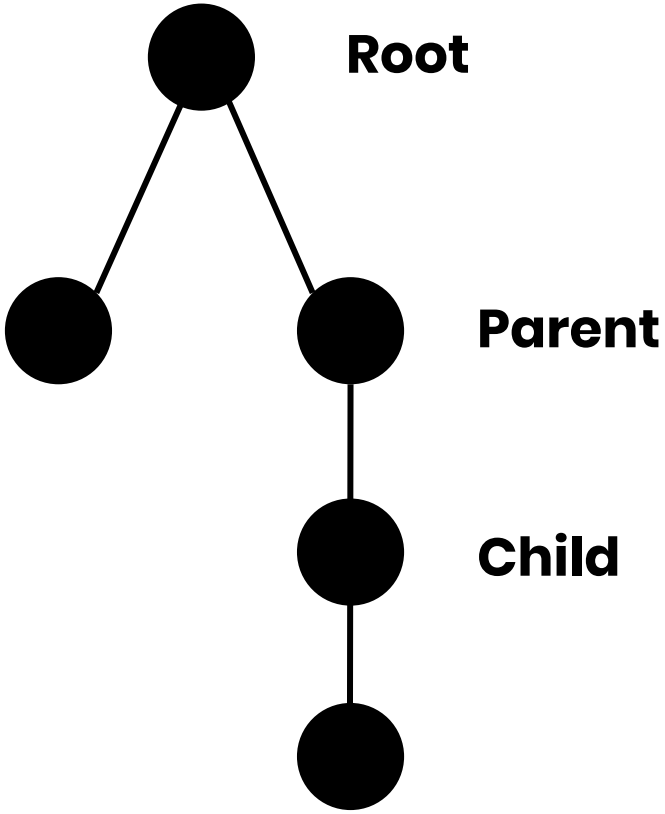

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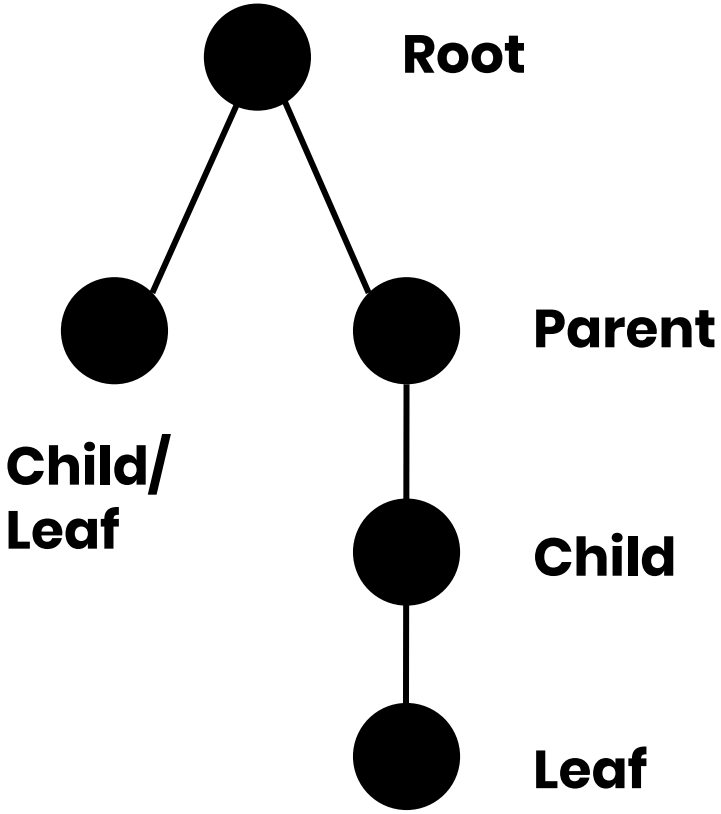

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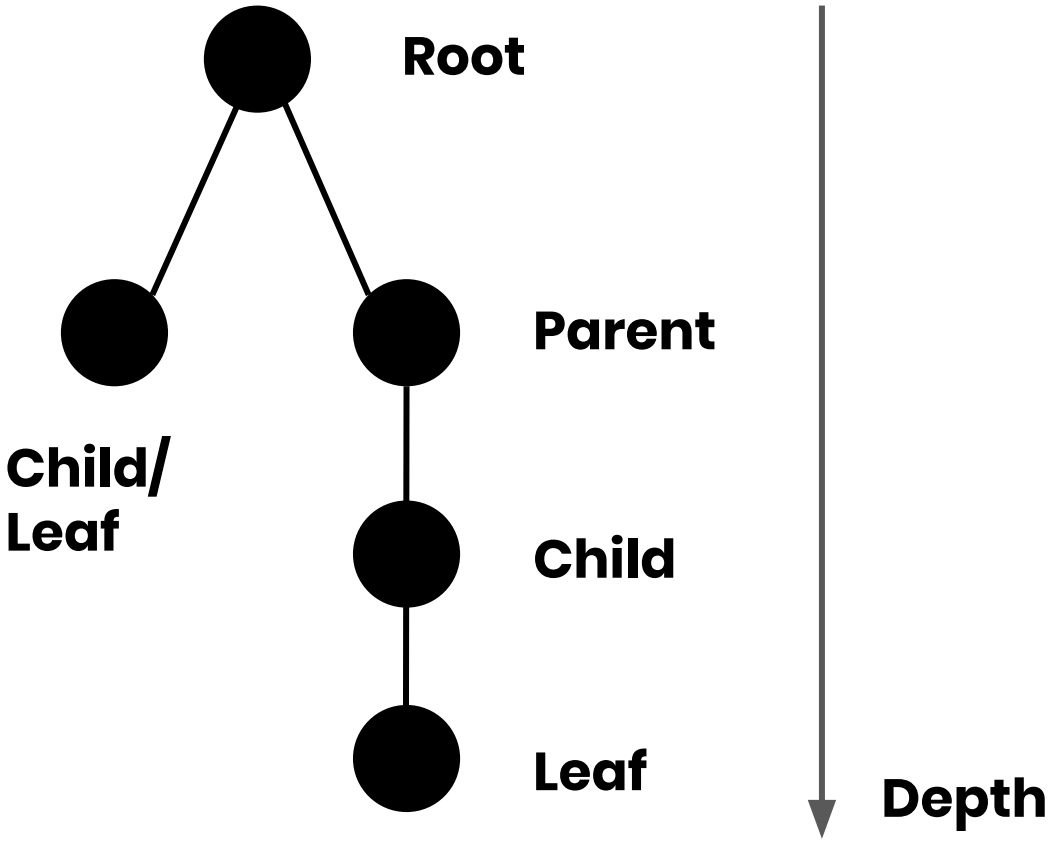

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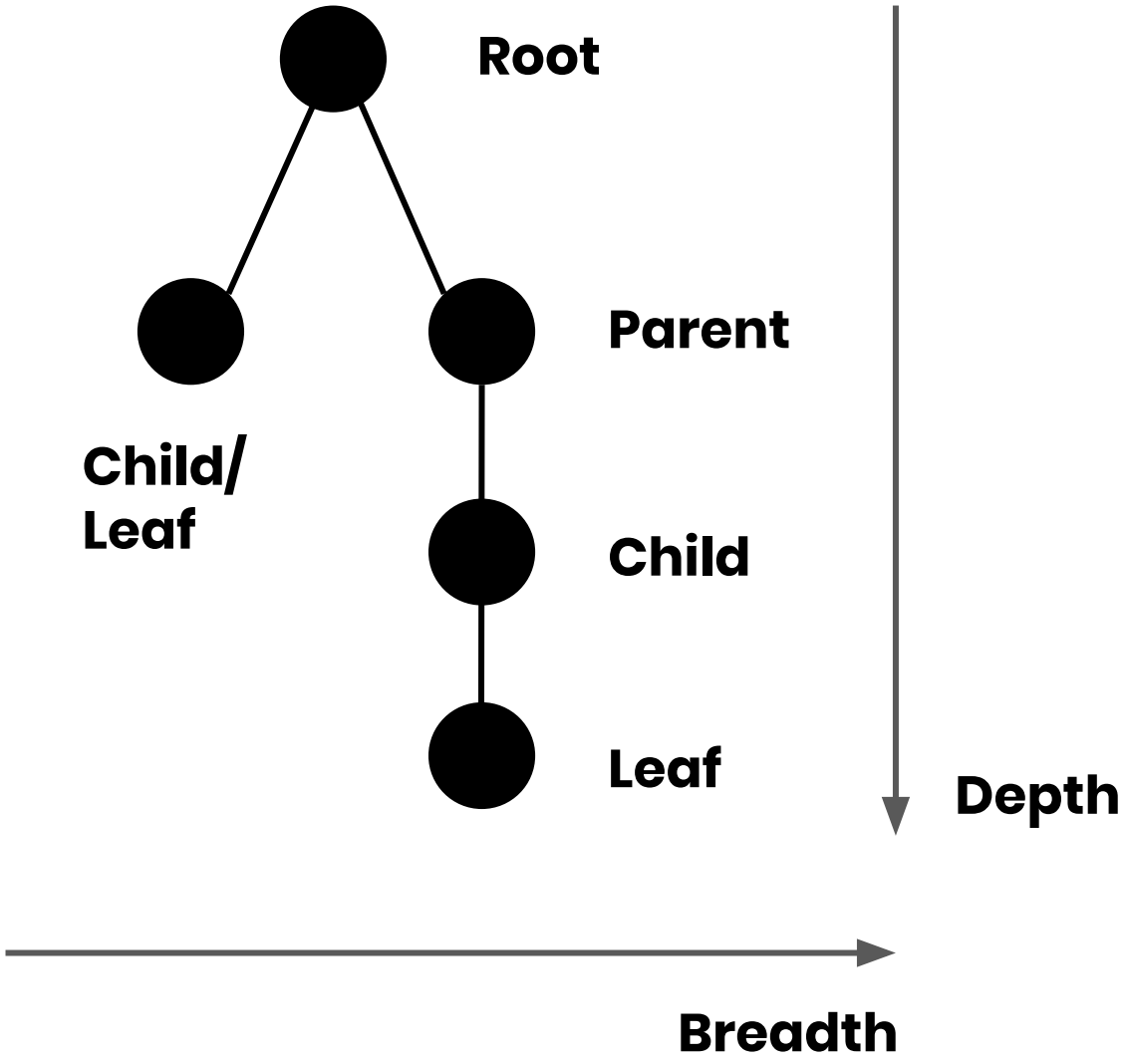
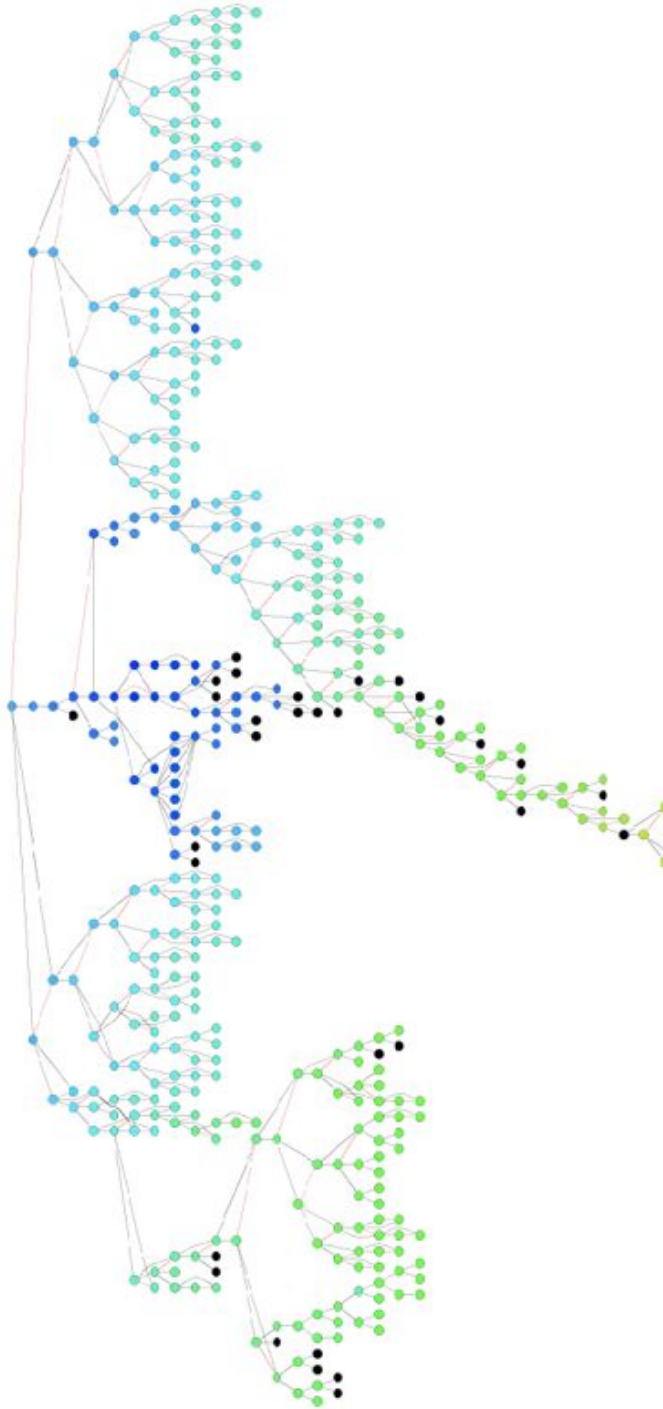


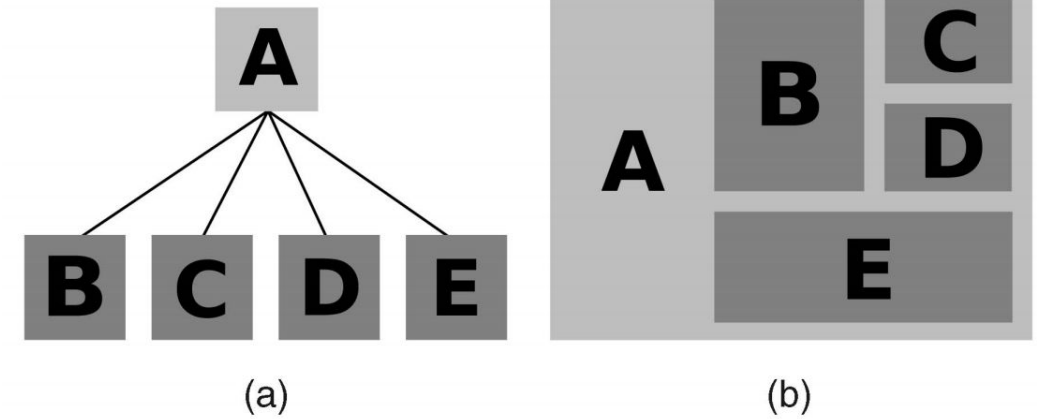
Visualizing Trees

- How many nodes?
- How bread is the tree?
- How deep it the tree?
- Is the tree balanced?
- Which branches are largest?
- Which nodes have most children?
- Node/link attributes …



Explicit vs. Implicit

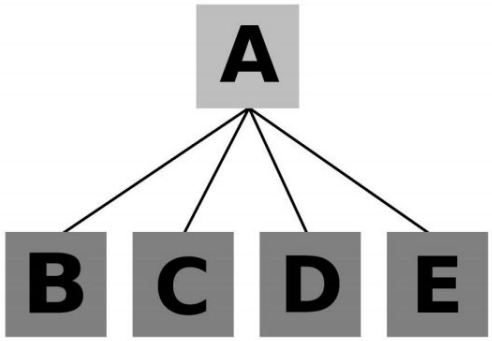
Explicit
(Lines)



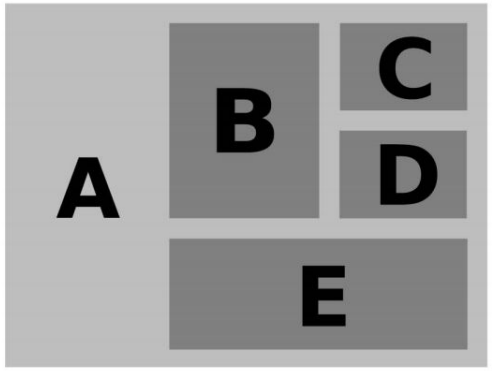
Implicit
(inclusion)

Explicit vs. Implicit

Explicit
(Lines)



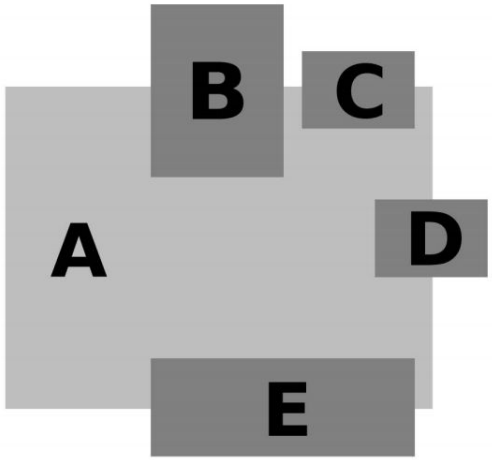
(a)



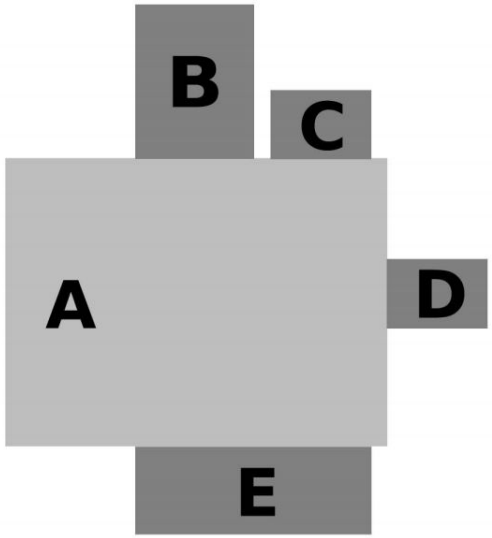
(b)

Implicit
(inclusion)

Implicit
(overlap)



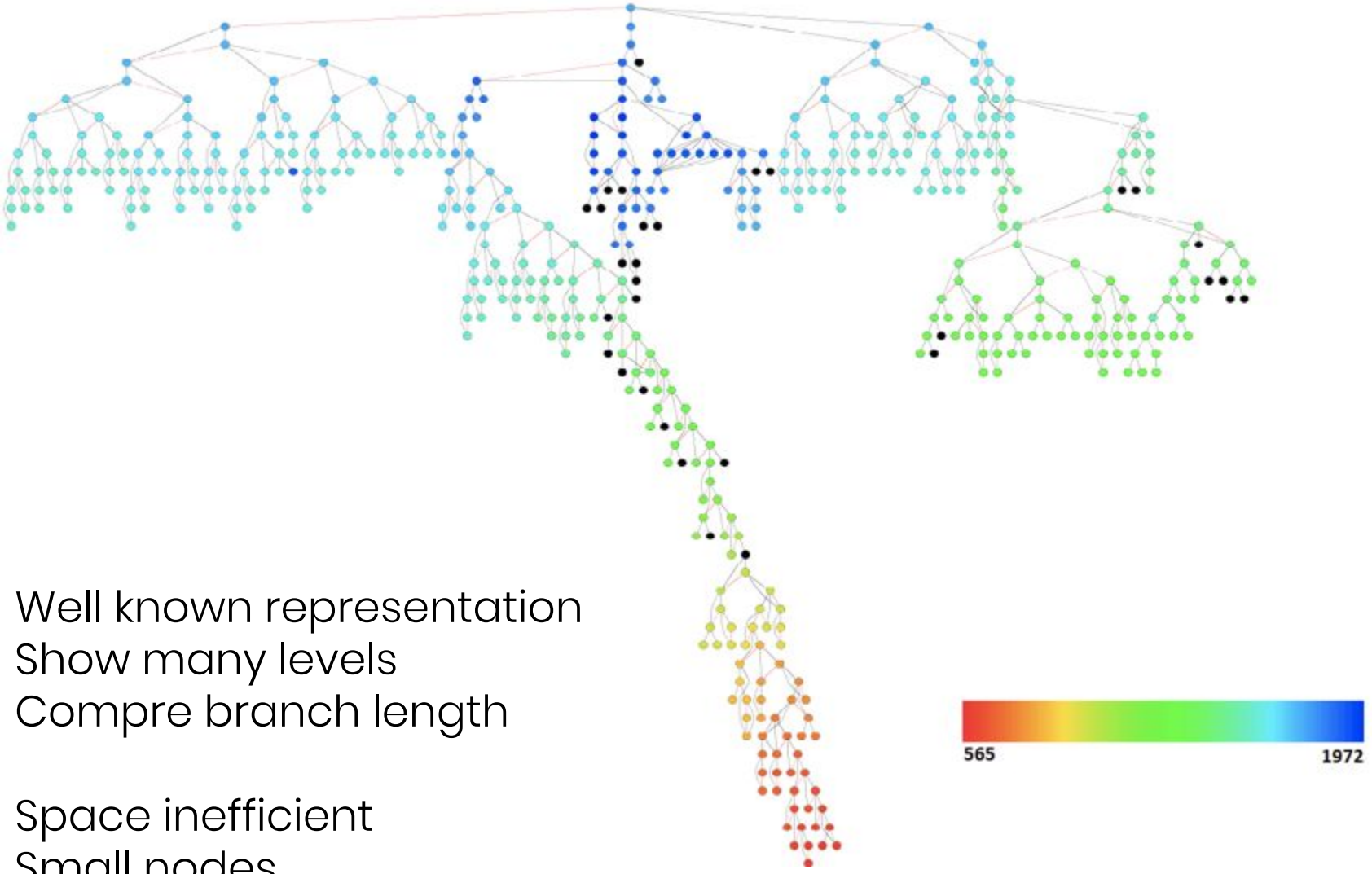
(c)



(d)

Implicit
(adjacency)

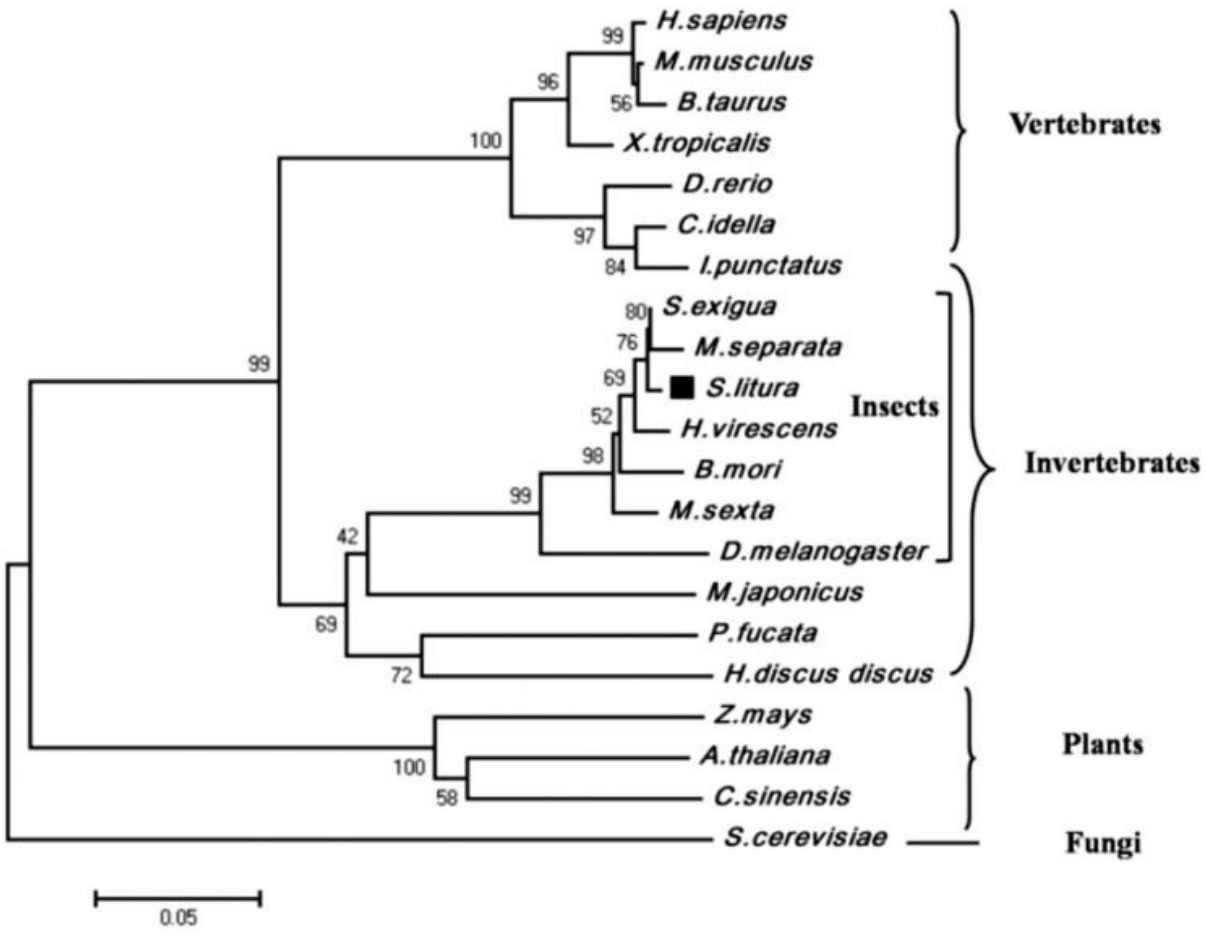
Explicit: Node-link Diagram



+ Well known representation
+ Show many levels
+ Compre branch length

- Space inefficient
- Small nodes

Explicit: Dendogram / Phylogram

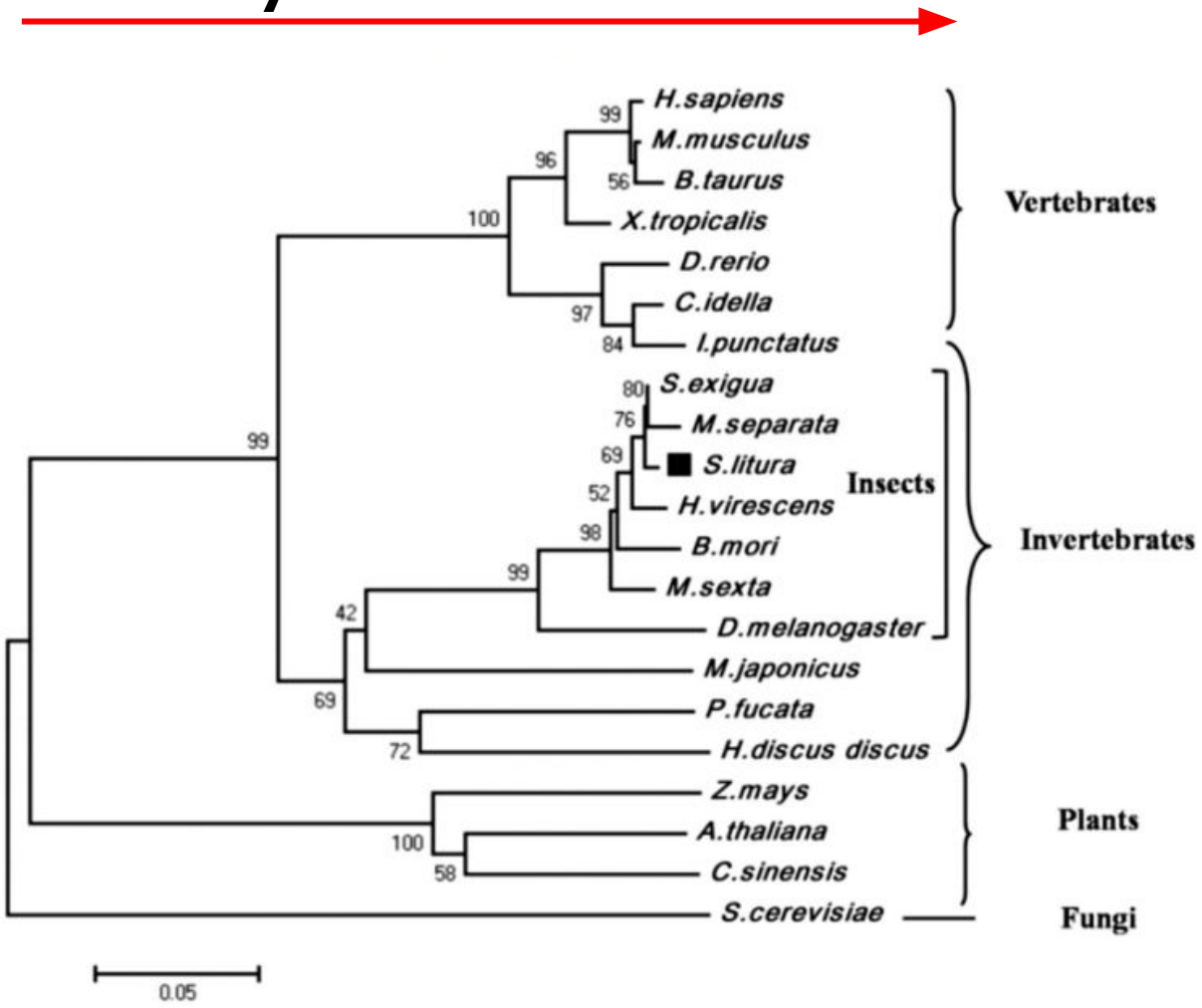


\+ Shows similarity

\- Only 2 children
\- Parent nodes not named

Explicit: Dendogram / Phylogram

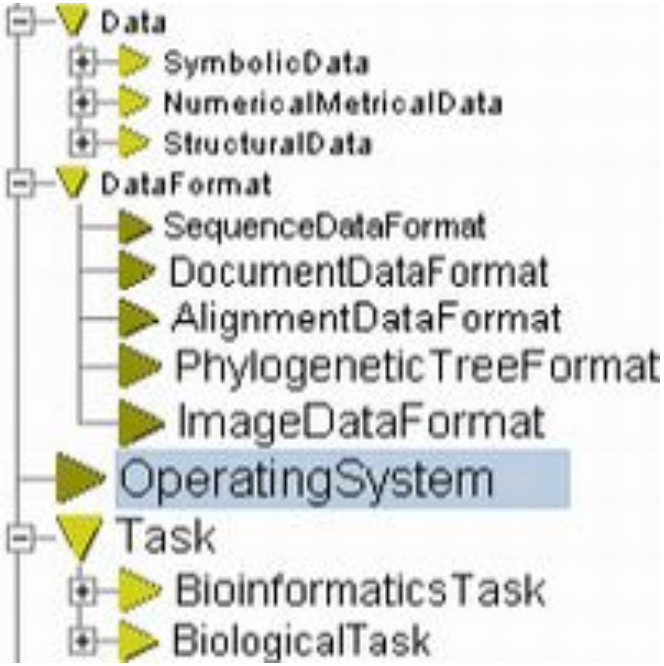
Similarity



\+ Shows similarity

\- Only 2 children
\- Parent nodes not named

Explicit: **File-browser**



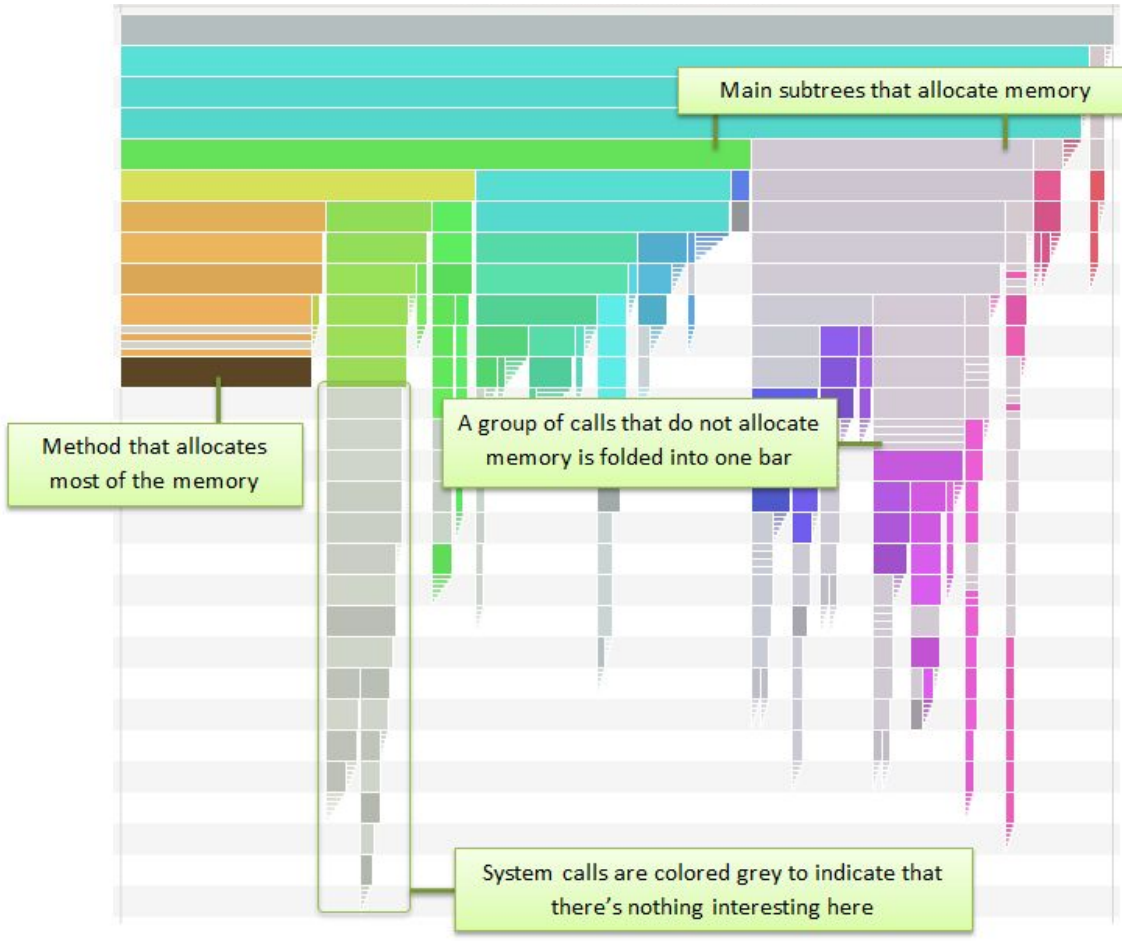
Interactive open and close

Implicit: **Icicle plot**

Node = squares
Relations = adjacency

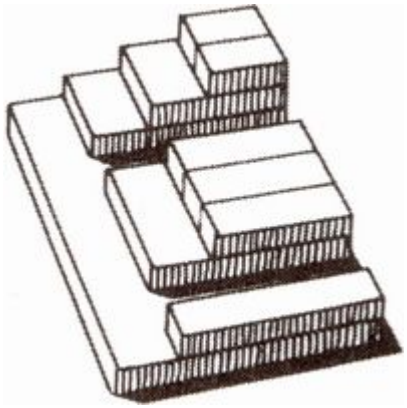
+ Can represent time
+ Depth clearly visible
+ Provides space for text
+ Can show time

- Leaves can get very small



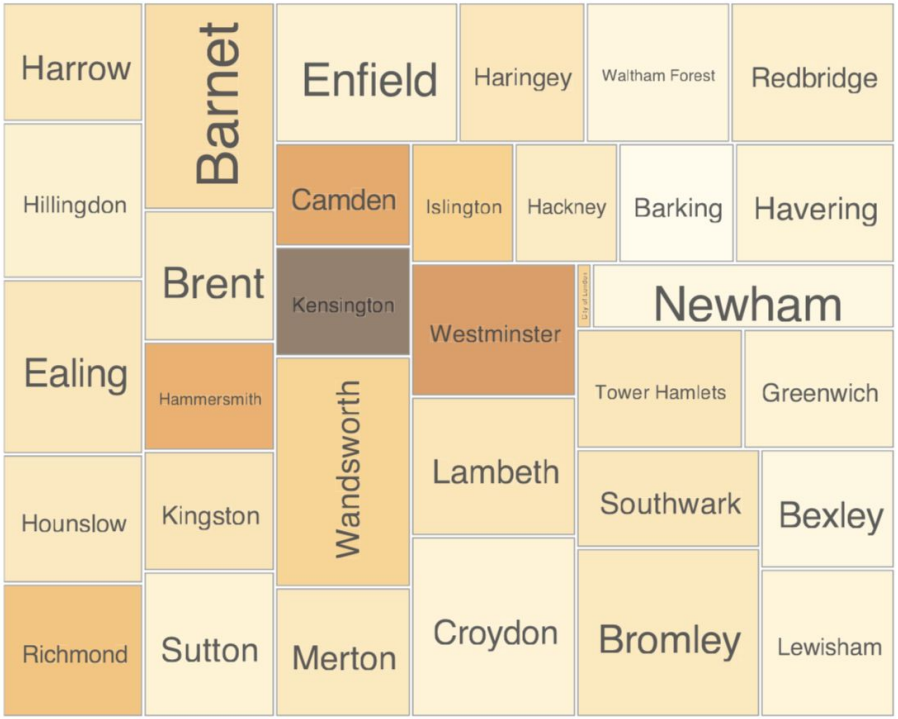
Implicit: **Treemap**

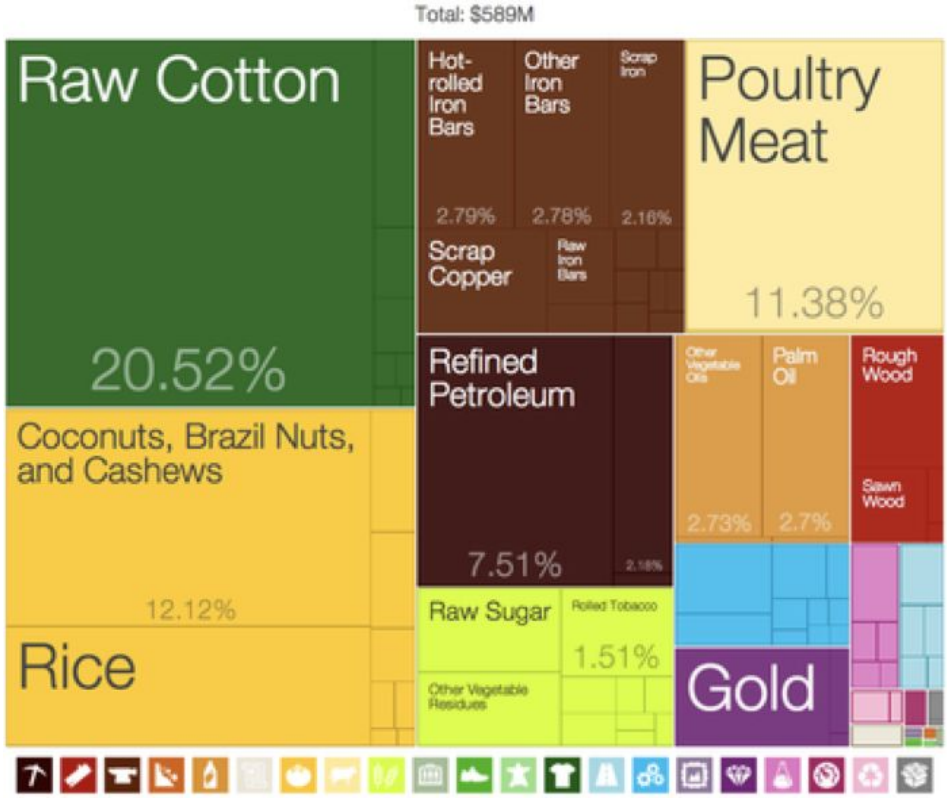
+ Space-filling
+ Size encodes information
+ Space for additional visual encoding (color)



Shneiderman, Ben, and Catherine Plaisant. "Treemaps for space-constrained visualization of hierarchies." (1998).

Treemap: **Additional Variables**

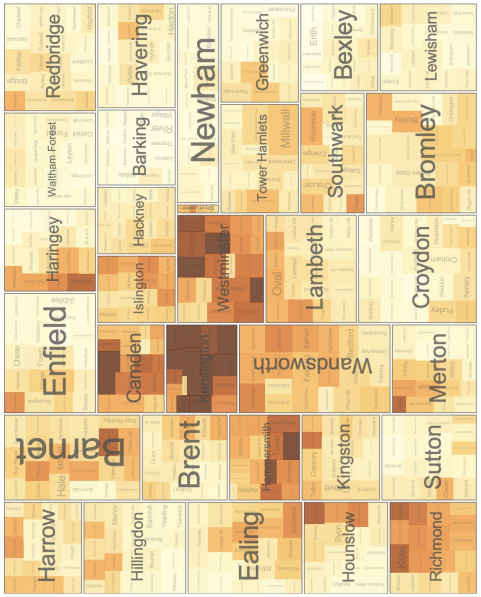




Slingsby, Aidan, Jason Dykes, and Jo Wood. "Configuring hierarchical layouts to address research questions." *IEEE transactions on visualization and computer graphics* 15.6 (2009): 977-984.

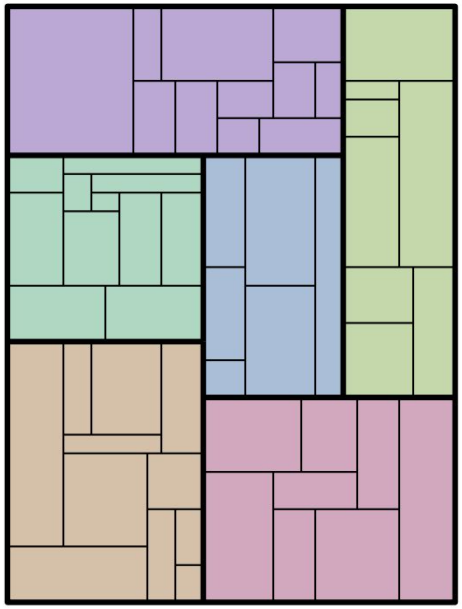
Treemap: **Visualizing depth?**

Labeling



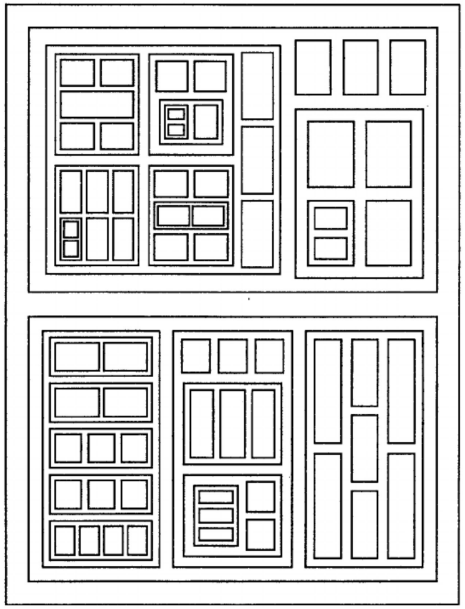
Slingsby, Aidan, Jason Dykes, and Jo Wood. "Configuring hierarchical layouts to address research questions." *IEEE transactions on visualization and computer graphics* 15.6 (2009): 977-984.

Coloring



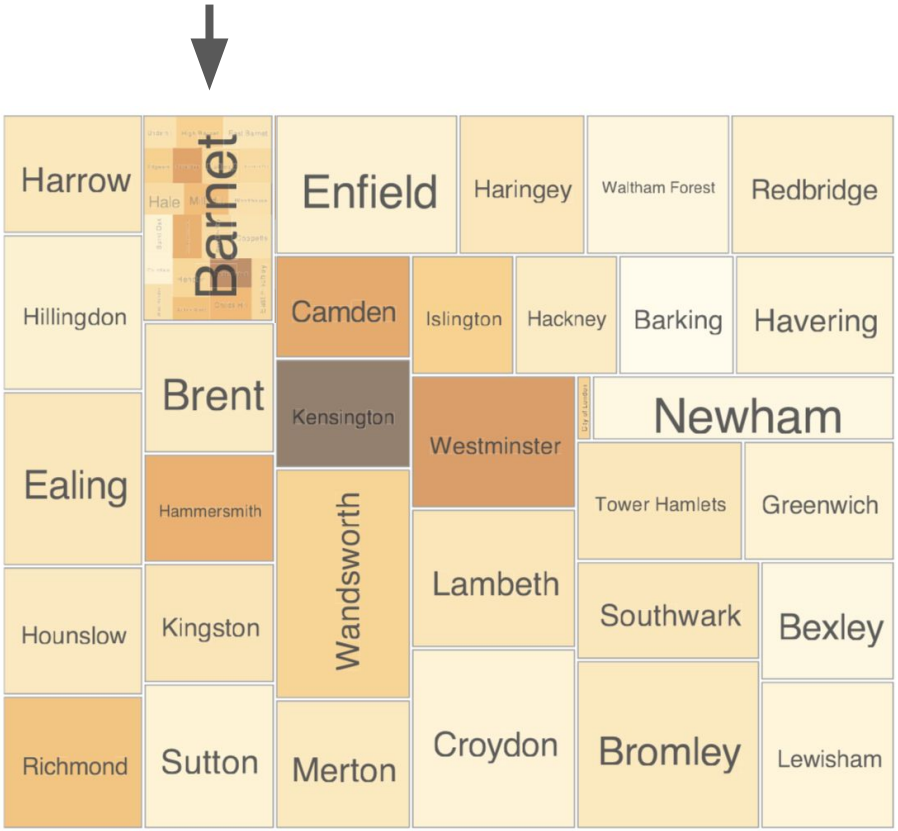
Buchin, Kevin, et al. "Adjacency-preserving spatial treemaps." *Workshop on Algorithms and Data Structures*. Springer, Berlin, Heidelberg, 2011.

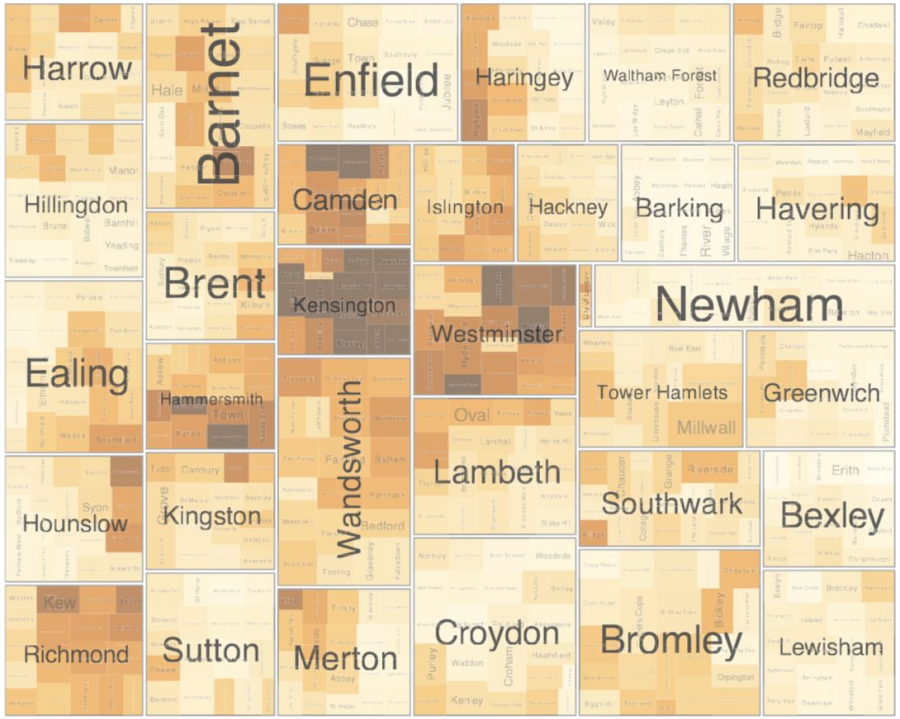
Spacing



Harel, David, and Gregory Yashchin. "An algorithm for blob hierarchy layout." *The Visual Computer* 18.3 (2002): 164-185.

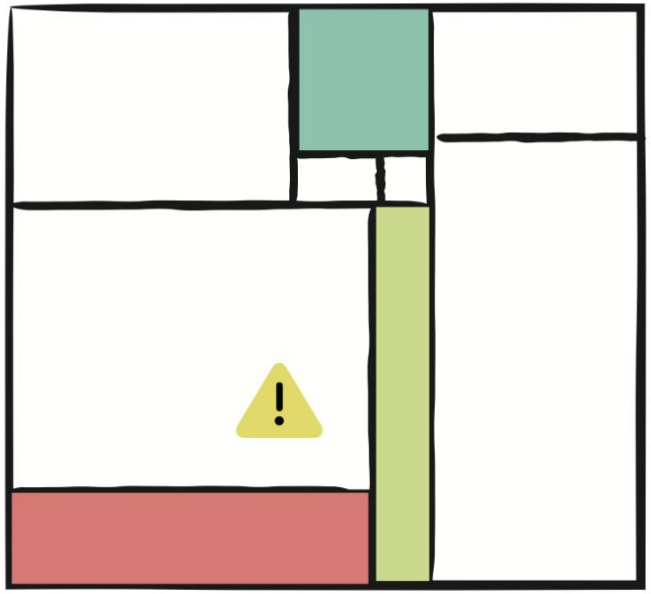
Treemap: **Interaction**

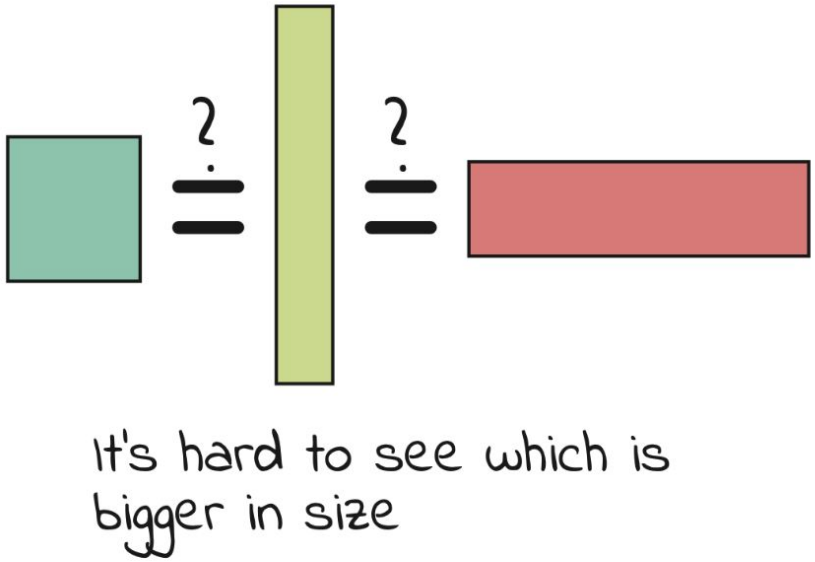




Slingsby, Aidan, Jason Dykes, and Jo Wood. "Configuring hierarchical layouts to address research questions." *IEEE transactions on visualization and computer graphics* 15.6 (2009): 977-984.

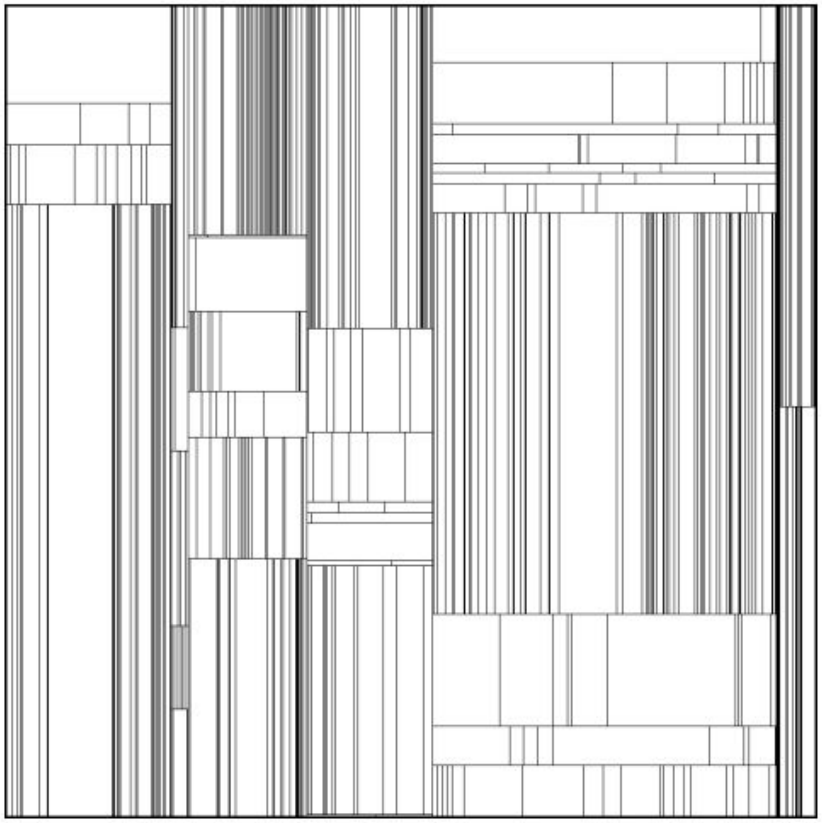
Treemaps **size comparison?**



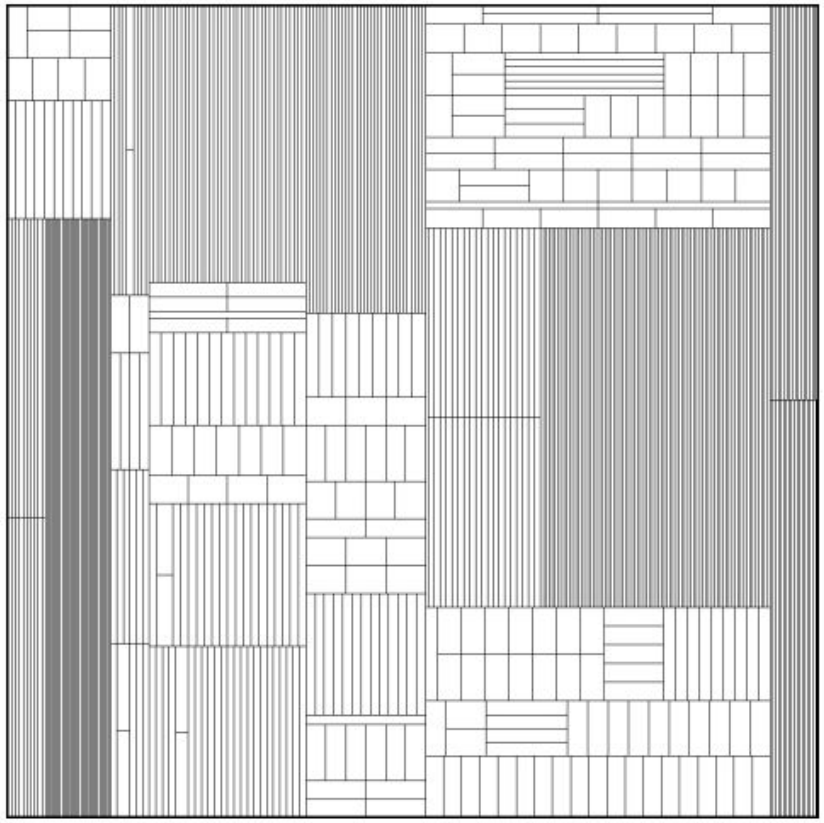


Hard due to different aspect ratios of rectangles

Treemap layouts: **Slice+Dice**

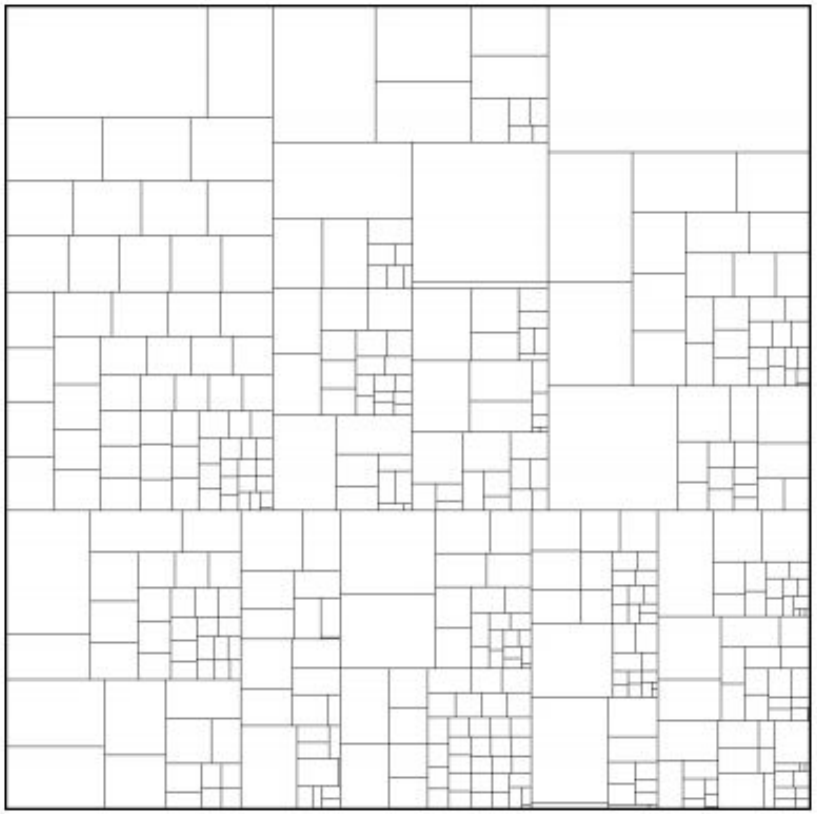


Different node sizes

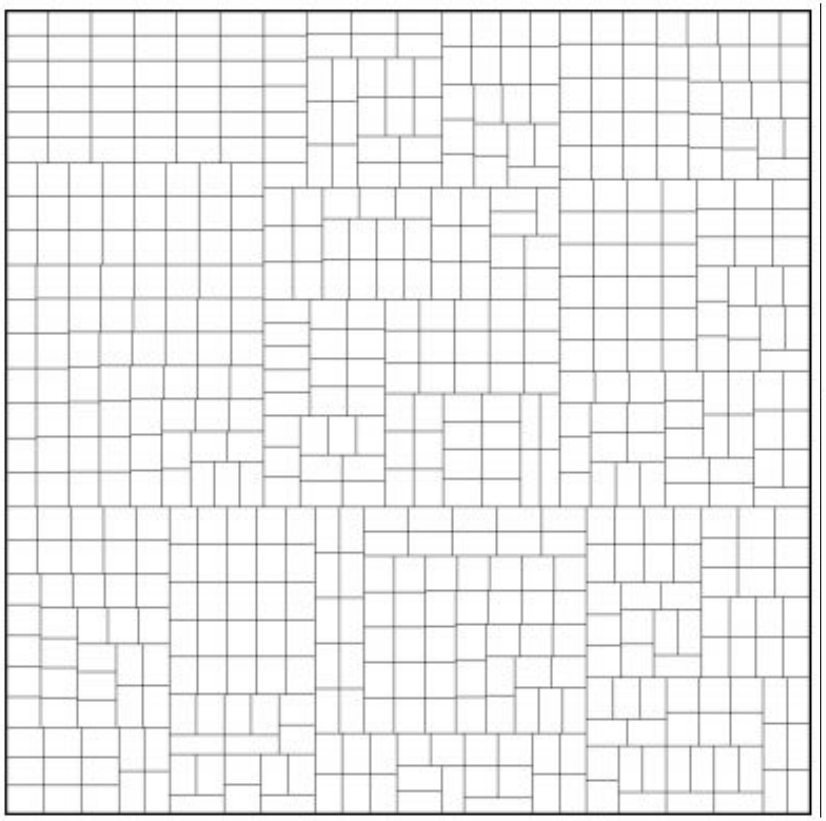


Same(!) node sizes

Treemap layouts: **Squarified**

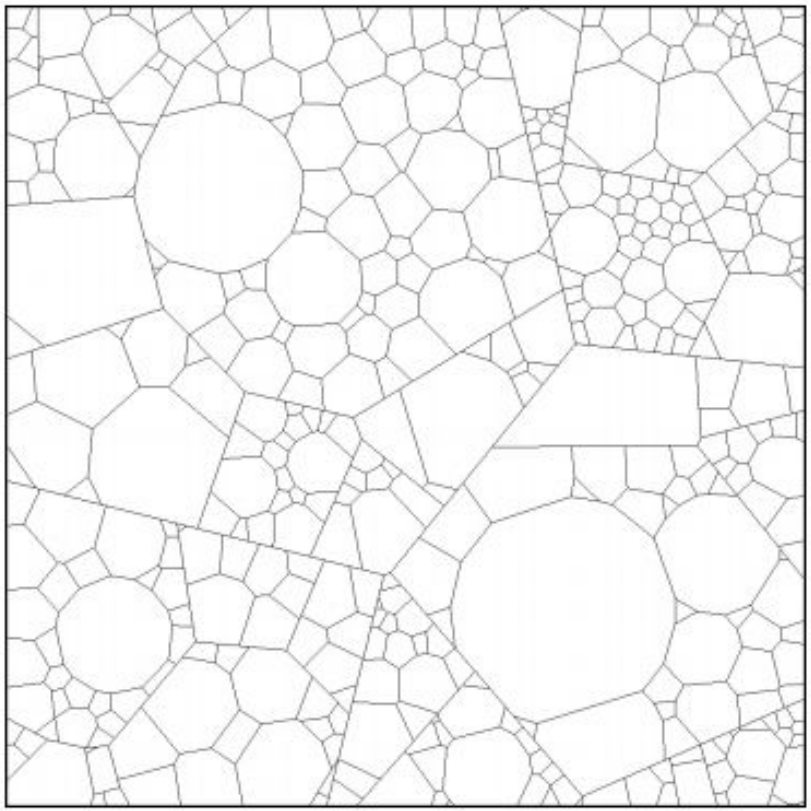


Different node sizes

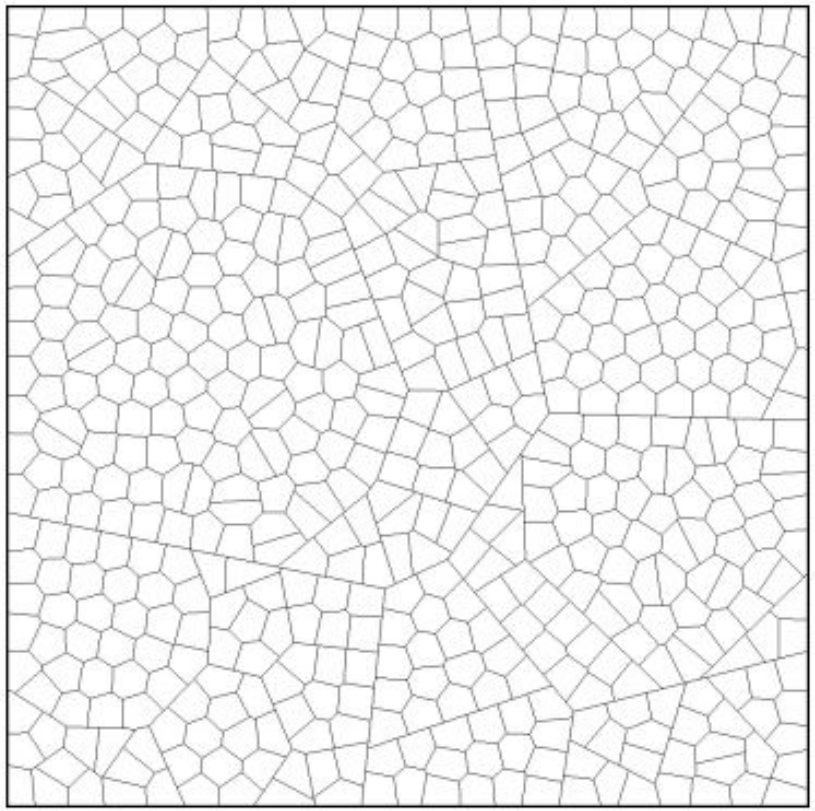


Same(!) node sizes

Treemap layouts: **Voroni**



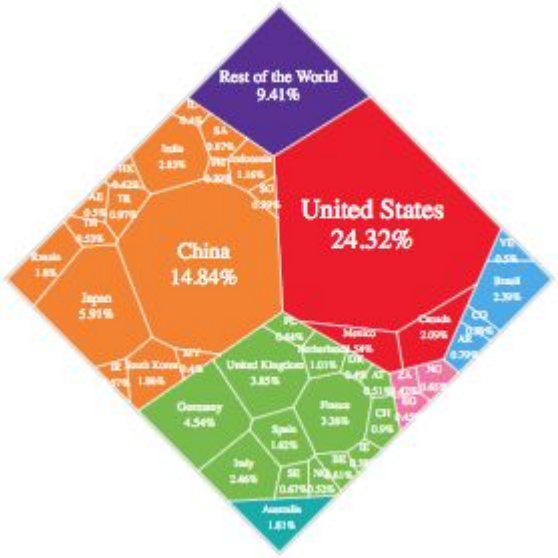
Different node sizes

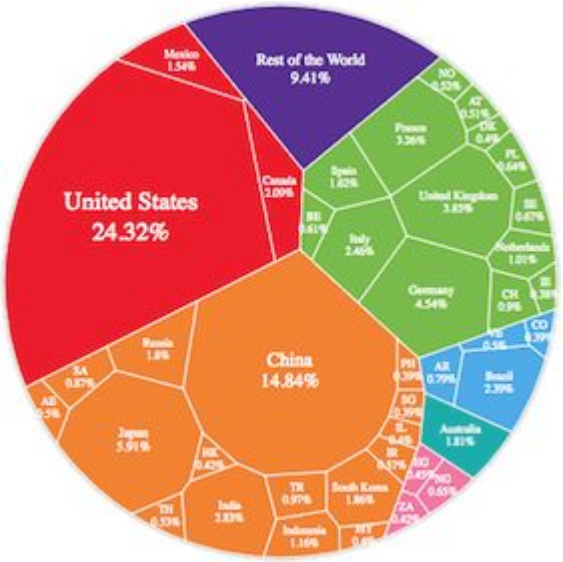


Same node sizes

Balzer, Michael, and Oliver Deussen. "Voronoi treemaps." *IEEE Symposium on Information Visualization, 2005. INFOVIS 2005.*. IEEE, 2005.

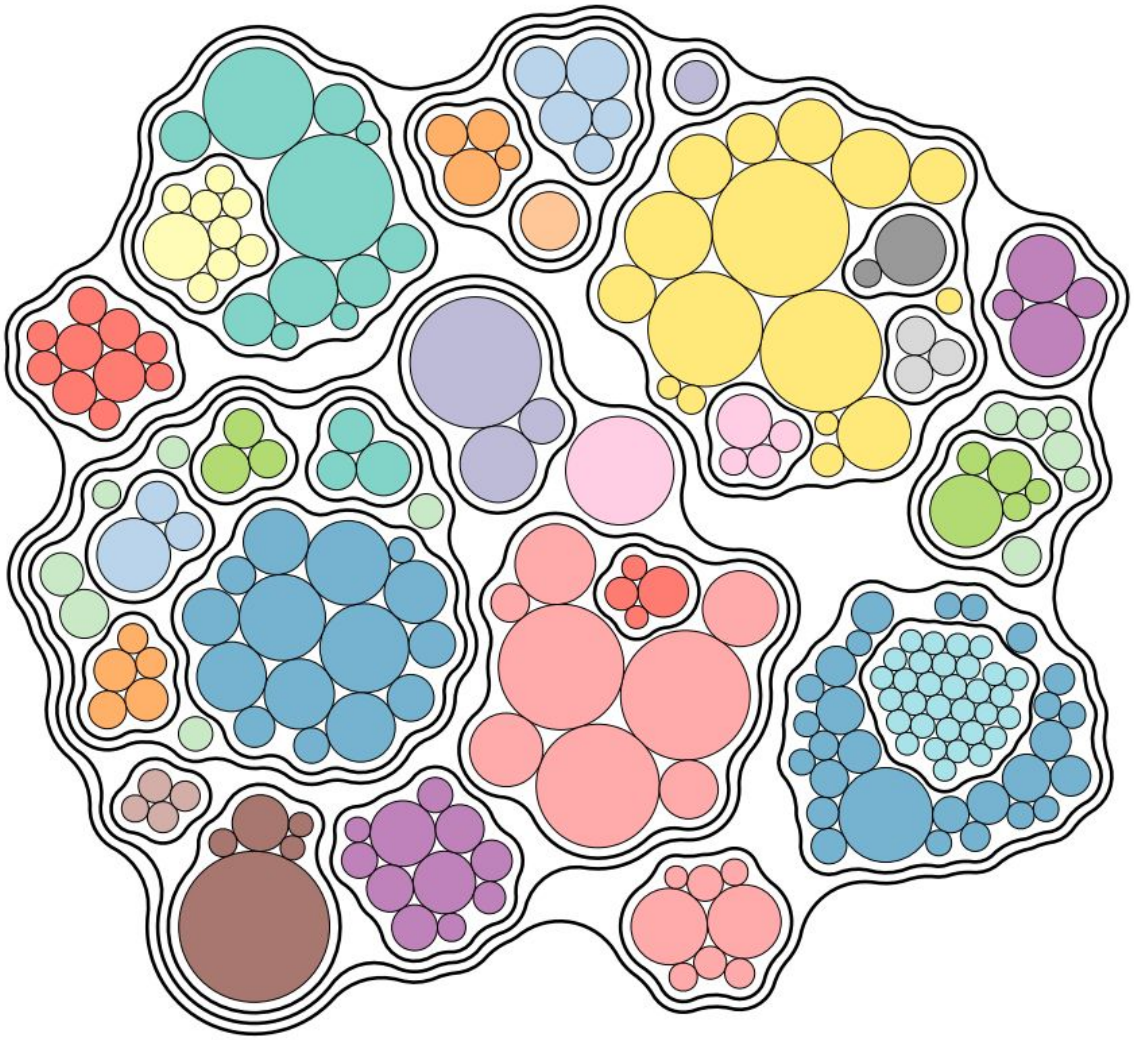
More Voroni layouts

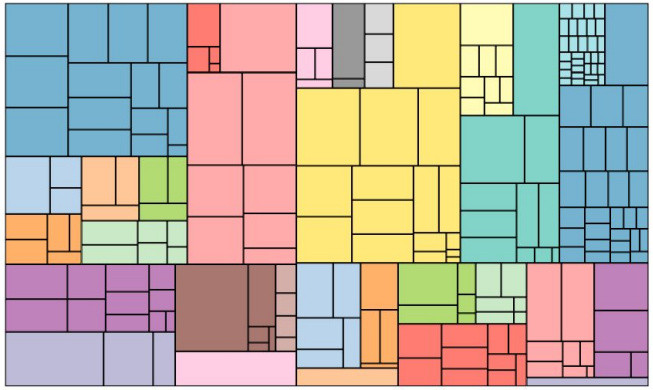




https://github.com/Kcnarf/d3-voronoi-treemap

Bubble Treemaps





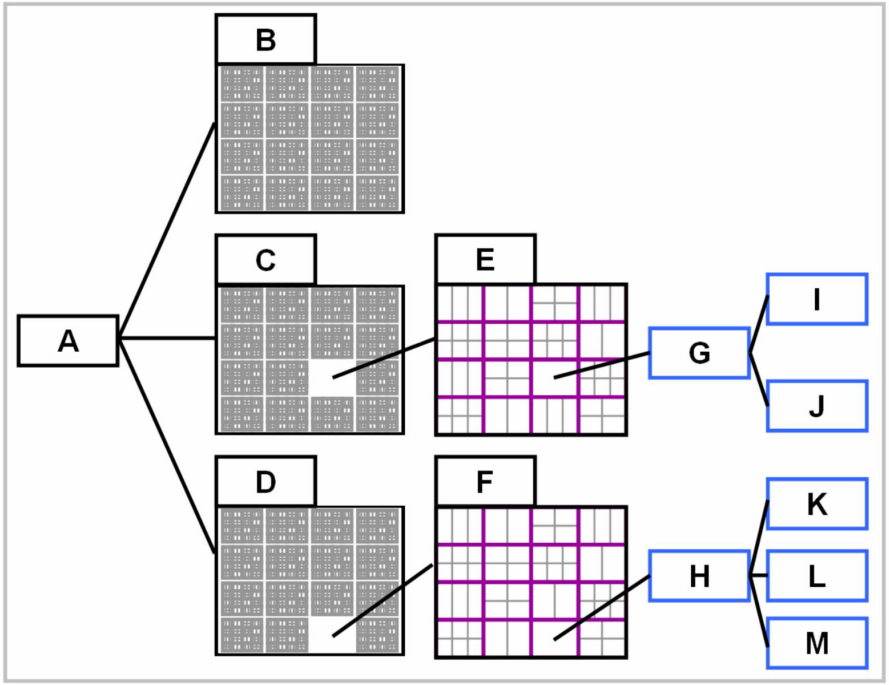
+ Good comparison of sizes

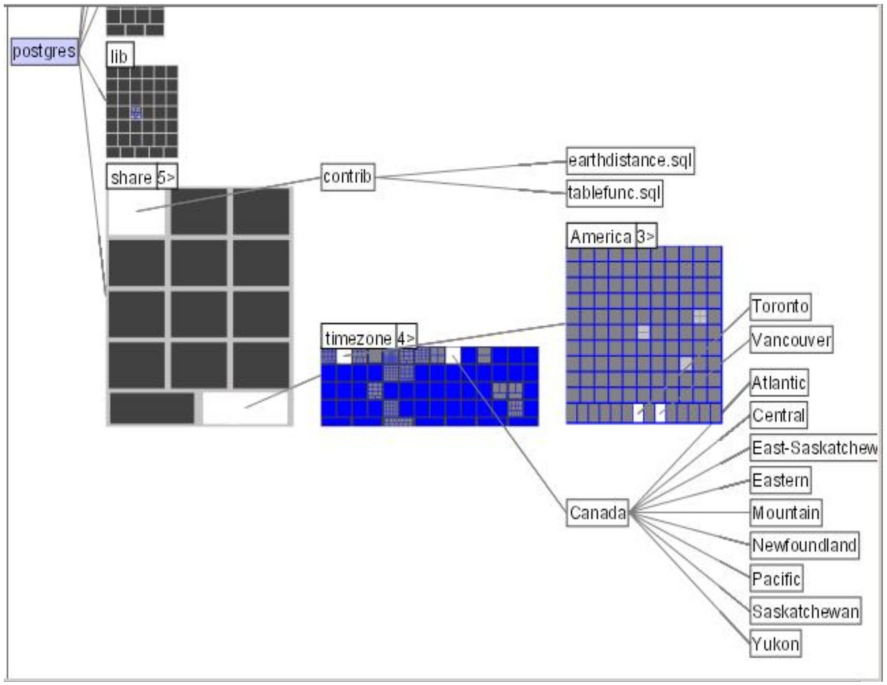
- Understanding of depth? Perhaps use color shades?

Görtler, Jochen, et al. "Bubble treemaps for uncertainty visualization." *IEEE transactions on visualization and computer graphics* 24.1 (2017): 719-728.

Treemap + Nodelink
Elastic Hierarchies
Hybrid

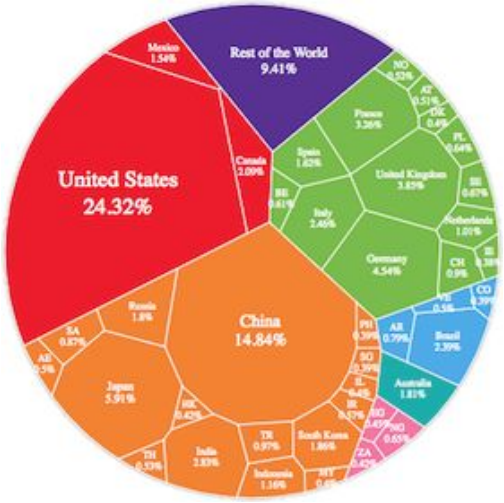
- Combine space-filling and compact view of matrices, with
- Effective visualization of hierarchy levels
- Efficient with interaction

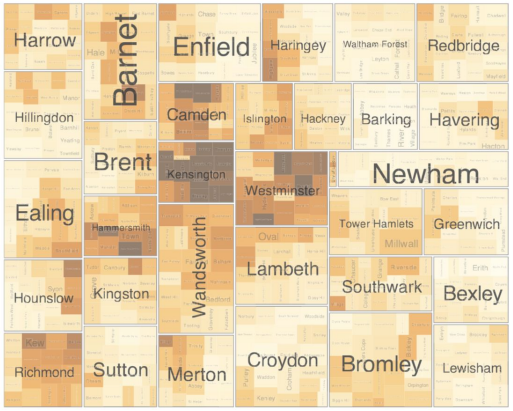




Zhao, Shengdong, Michael J. McGuffin, and Mark H. Chignell. "Elastic hierarchies: Combining treemaps and node-link diagrams." *IEEE Symposium on Information Visualization, 2005. INFOVIS 2005.*. IEEE, 2005.

Problem!?!


Rest of the World
9.41%
United States
24.32%
China
14.84%


Harrow
Barnet
Enfield
Haringey
Waltham Forest
Redbridge
Hillingdon
Camden
Islington
Hackney
Barking
Havering
Brent
Kensington
Westminster
Newham
Ealing
Hammersmith
Tower Hamlets
Greenwich
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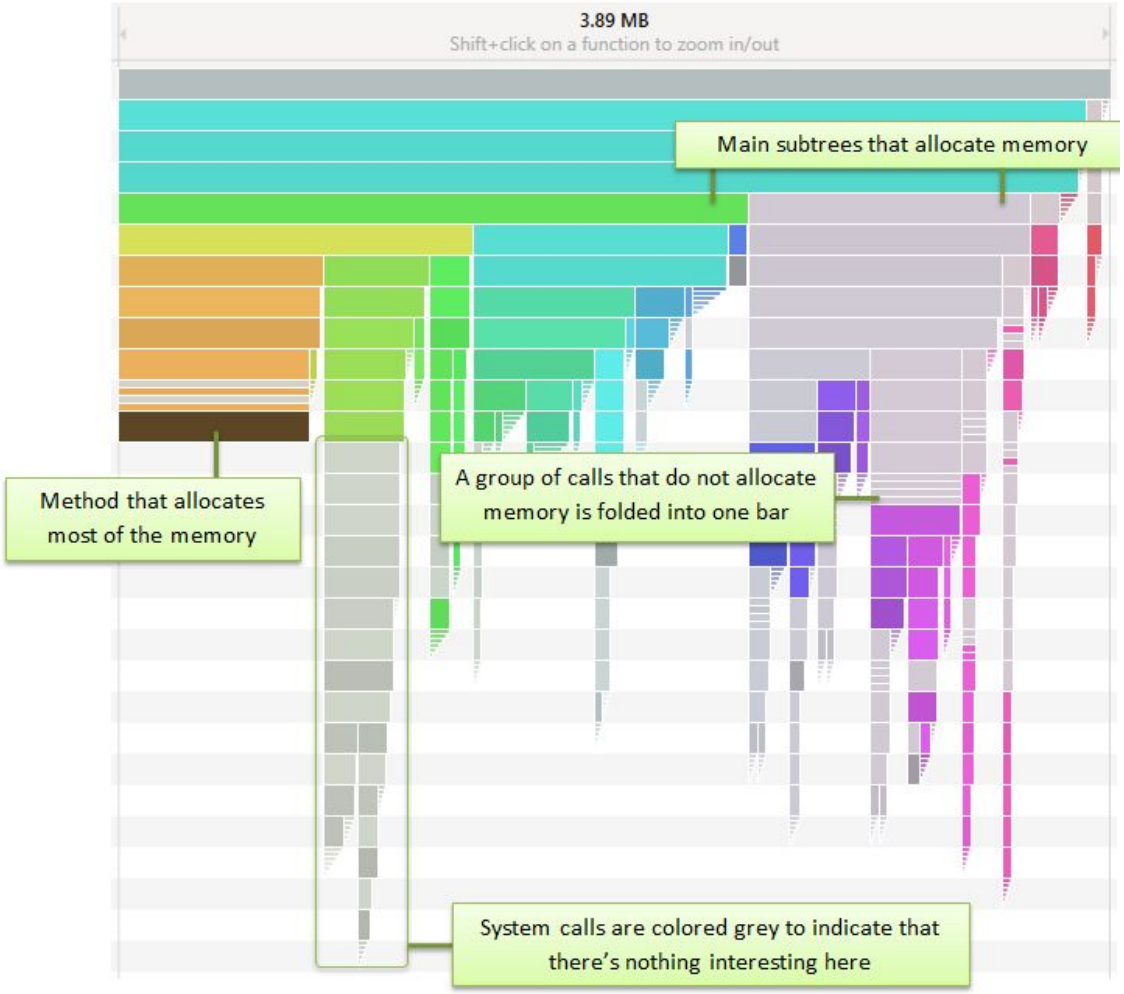
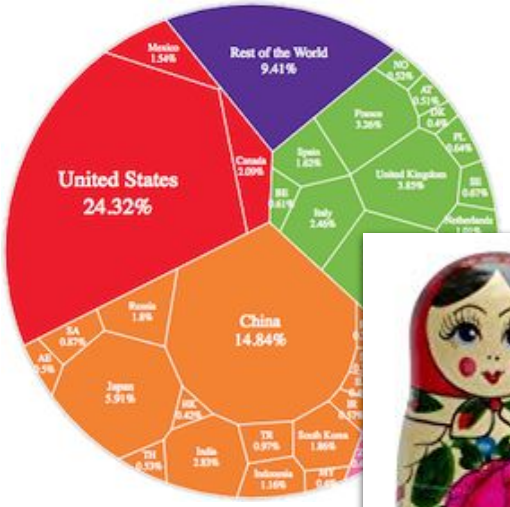
Lambeth
Hounslow
Kingston
Southwark
Bexley
Richmond
Sutton
Merton
Croydon
Bromley
Lewisham


3.89 MB
Shift+click on a function to zoom in/out
Main subtrees that allocate memory
Method that allocates most of the memory
A group of calls that do not allocate memory is folded into one bar
System calls are colored grey to indicate that there's nothing interesting here

Problem!?!


Rest of the World
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Harrow
Barnet
Enfield
Haringey
Hillingdon
Camden
Islington
Hackney
Brent
Kensington
Westminster
Newham
Ealing
Hammersmith
Tower Hamlets
Greenwich
Oval
Lambeth
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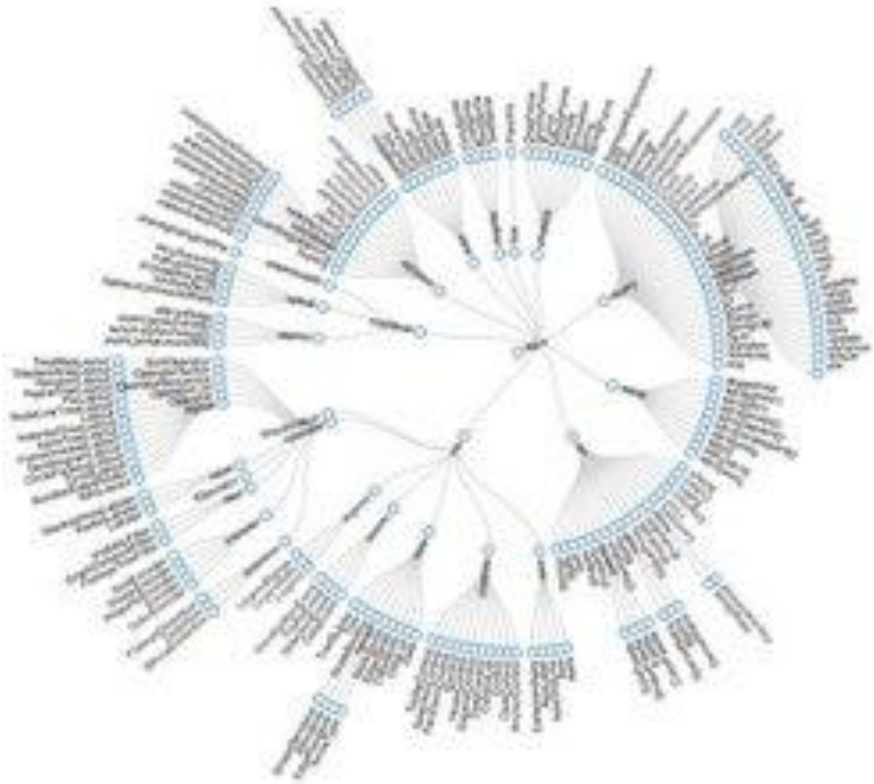
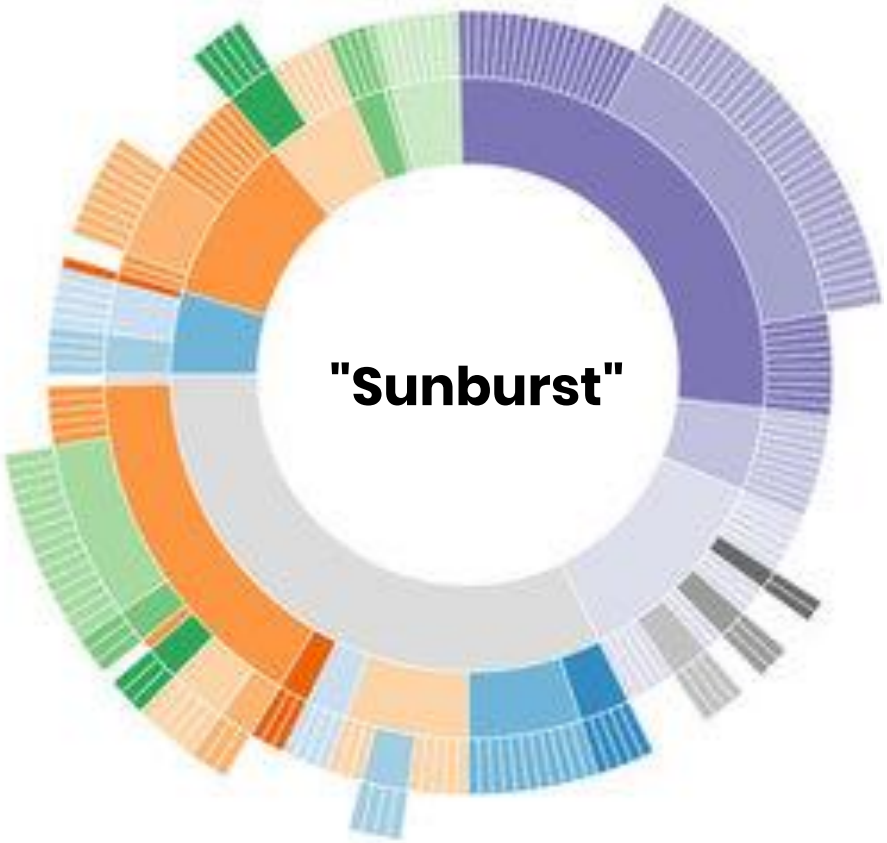
Hounslow
Kingston
Southwark
Bexley
Richmond
Sutton
Merton
Croydon
Bromley
Lewisham

3.89 MB
Shift+click on a function to zoom in/out
Main subtrees that allocate memory
hat do not allocate
ded into one bar
System calls are colored grey to indicate that there's nothing interesting here

Polar layouts
More spae for children



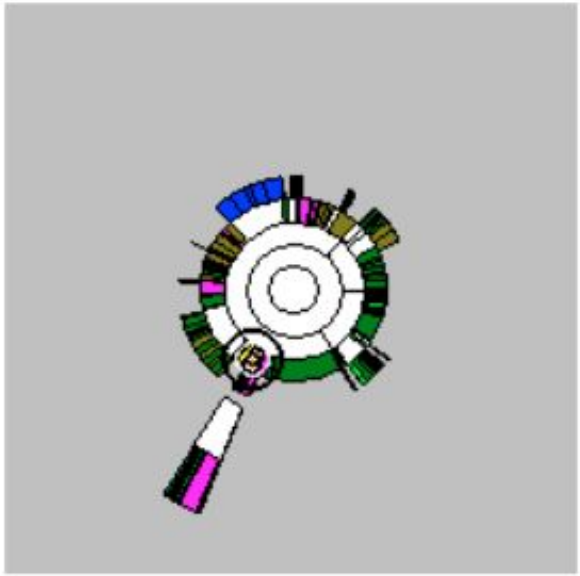
Explicit: Node-link

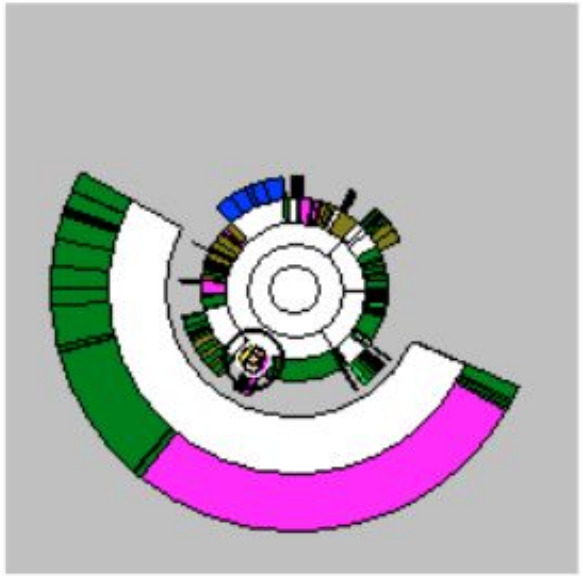


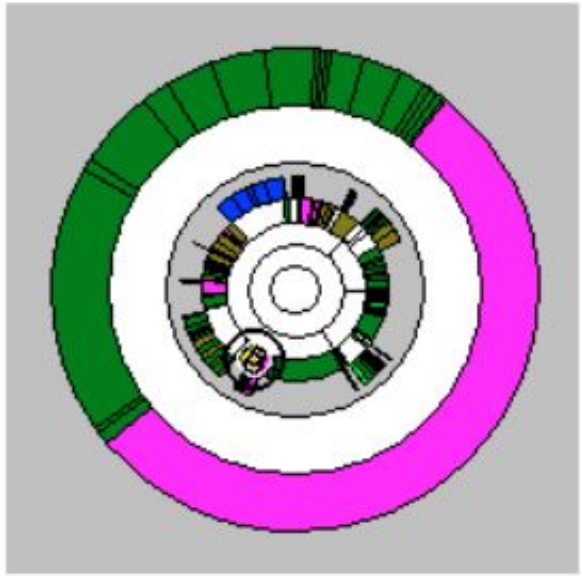
Implicit

Stasko, John, and Eugene Zhang. "Focus+ context display and navigation techniques for enhancing radial, space-filling hierarchy visualizations." *IEEE Symposium on Information Visualization 2000. INFOVIS 2000. Proceedings*. IEEE, 2000.

Polar Layout:
Even more space for children



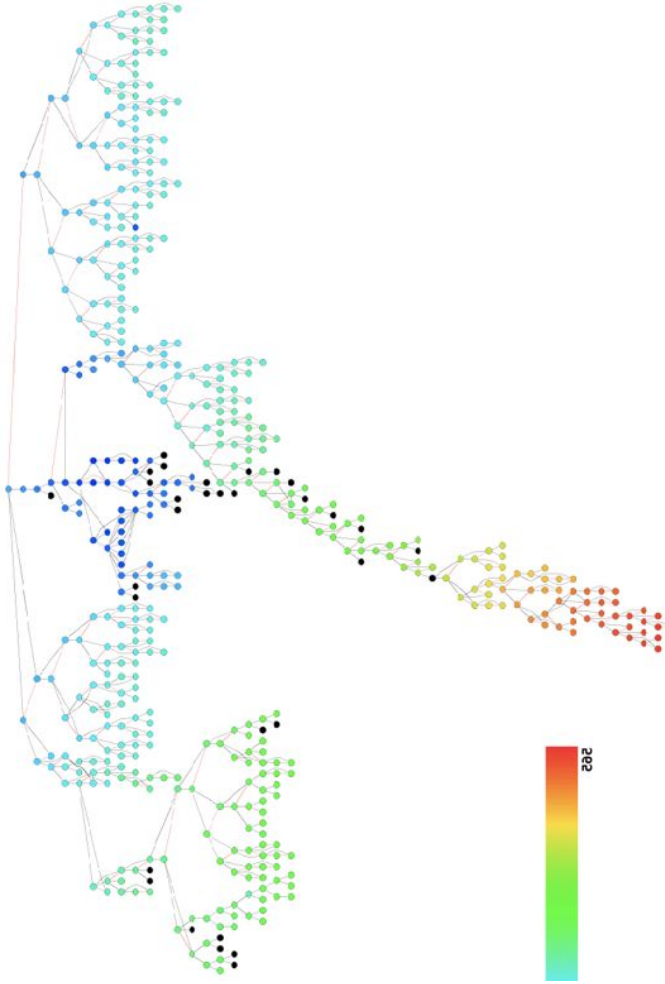




Interactive enlargement of children at 2nd level

Stasko, John, and Eugene Zhang. "Focus+ context display and navigation techniques for enhancing radial, space-filling hierarchy visualizations." *IEEE Symposium on Information Visualization 2000. INFOVIS 2000. Proceedings*. IEEE, 2000.

Techniques
Wrap up



Online Course
Data Visualization for Professionals

THE UNIVERSITY of EDINBURGH

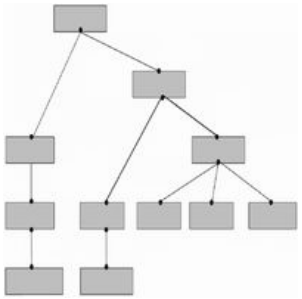
Benjamin Bach
June 2020
http://benjbach.me
https://datavis-online.github.io

-- Not for external use --

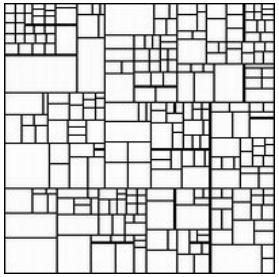
Tree Representations

Representation:

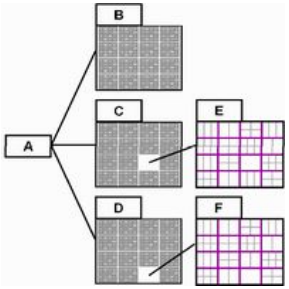
Explicit



Implicit



Hybrid



https://treevis.net/

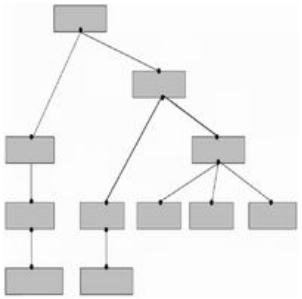
Tree Representations

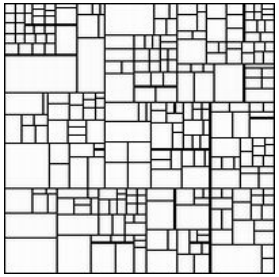
Representation:

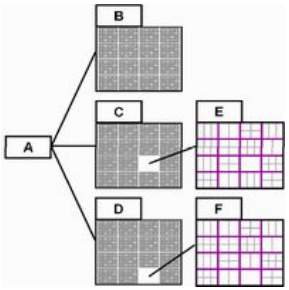
Explicit **Implicit** **Hybrid**

Alignment:

Axis parallel

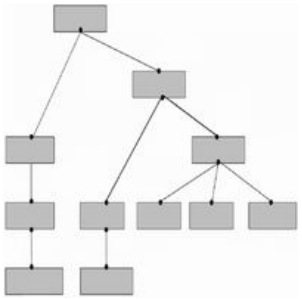
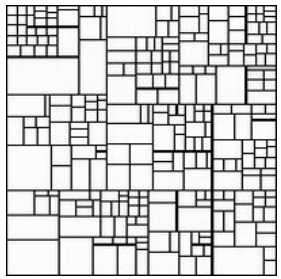
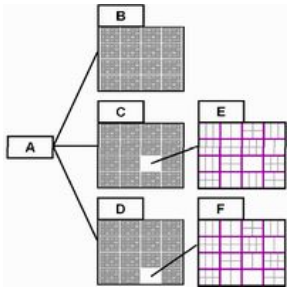
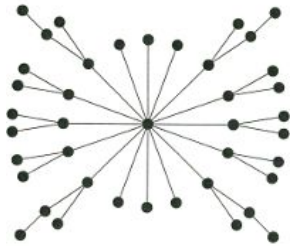
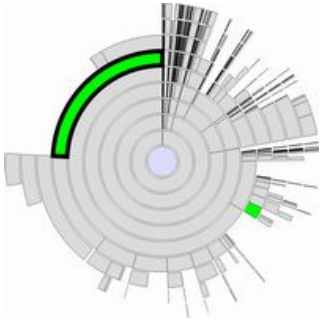






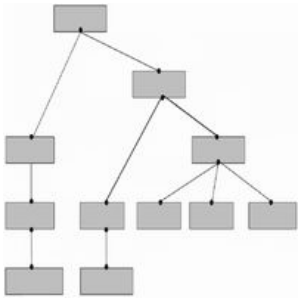
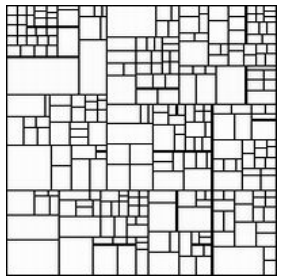
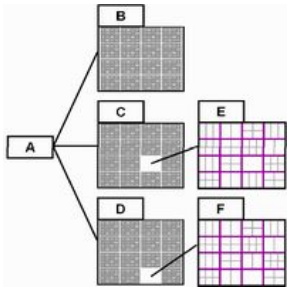
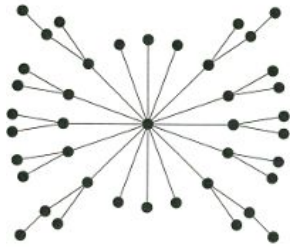
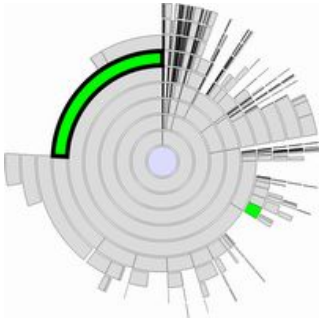
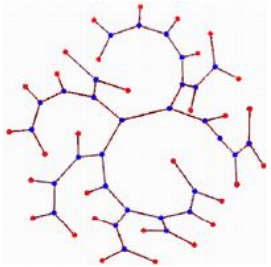
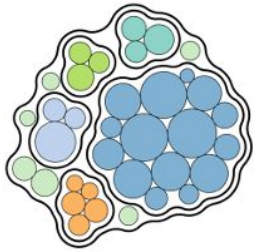
https://treevis.net/

Tree Representations

Representation:	Explicit	Implicit	Hybrid
Alignment:			
Axis parallel			
Polar			

https://treevis.net/

Tree Representations

Representation:	**Explicit**	**Implicit**	**Hybrid**
Alignment:			
Axis parallel			
Polar			
Free			

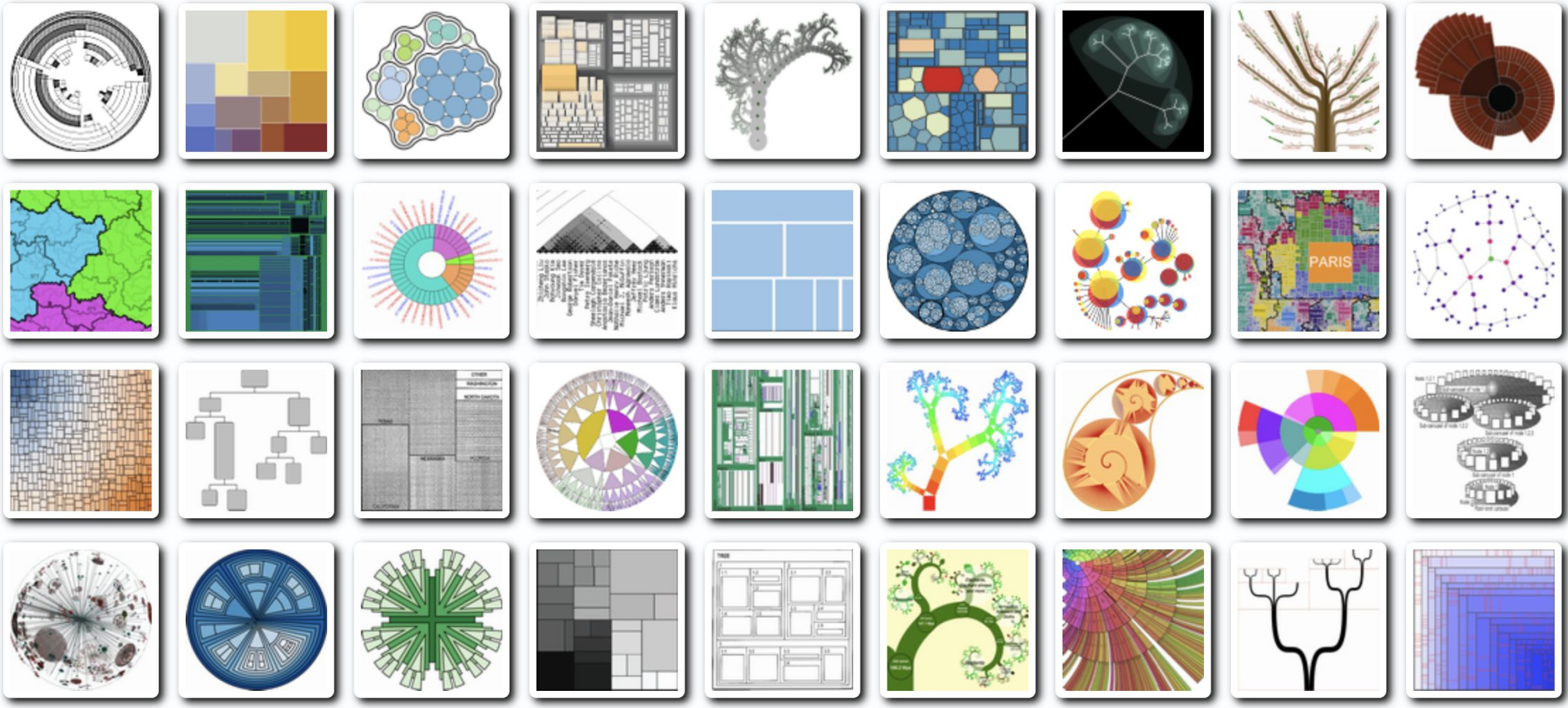
https://treevis.net/

TreeVis.net

Schulz, Hans-Jorg. "Treevis. net: A tree visualization reference." *IEEE Computer Graphics and Applications* 31.6 (2011): 11-15.

Dimensionality | Representation | Alignment | Fulltext Search | Techniques Shown

All | All | All | 306



Further Readings

- Schulz, Hans-Jorg, Steffen Hadlak, and Heidrun Schumann. "The design space of implicit hierarchy visualization: A survey." *IEEE transactions on visualization and computer graphics* 17.4 (2010): 393-411.