Total: \$589M Raw Cotton Hot-rolled Iron Bars Othe Iron Bars Poultry Meat Raw Iron Bars Scrap Copper 11.38% 20.52% Refined Rough Wood Petroleum Techniques Sawn Wood



# **Trees and Hierarchies**

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













# **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 vs. Implicit**



# Explicit: Node-link Diagram



- Small nodes

# Explicit: Dendogram / Phylogram



- + Shows similarity
- Only 2 children
  Parent nodes not named

# Explicit: Dendogram / Phylogram



0.05

### 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



Root

# 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

Coloring

#### Spacing



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.



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





bigger in size

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**



### **Bubble Treemaps**







- + Good comparison of sizes
- Understanding of depth? Perhaps use color shades?

### 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!?!



Harrow		Chase version Enfiel		Willy were the end	Redbridge
Hillingdon Bandi Vradio		Camden	Islington Hack	ney Starking	Havering
Yeardy Prove Townfeld	Brent	Kensington	Westminster	New	/ham
Ealing	Hammersmith			Tower Hamlets Millwall	Greenwich
Hounslow	Kingston	And the second s	Lambeth and the second	Southwark	Bexley
Richmond	Sutton	Merton	Croydon Water good and a second	Bromley	The second secon



### Problem!?!



### 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.



**Evolicit** 

**Representation:** 

	$\nearrow$	<b>`</b>		
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https://treevis.net/

**Representation:** 





Alignment:











Representation:



Explicit



Alignment:



Polar





Implicit











Representation:



Explicit



Alignment:



Polar

Free







Implicit

















### TreeVis.net

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



### **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.