Hierarchy and Tree Visualization

CS 4460 – Intro. to Information Visualization
October 23, 2014
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Hierarchies

- Definition
  - Data repository in which cases are related to subcases
  - Can be thought of as imposing an ordering in which cases are parents or ancestors of other cases

Hierarchies in the World

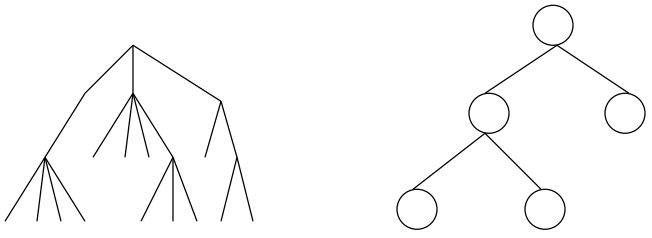
- Pervasive
  - Family histories, ancestries
  - File/directory systems on computers
  - Organization charts
  - Animal kingdom: Phylum,…, genus,…
  - Object-oriented software classes
  - …

Trees

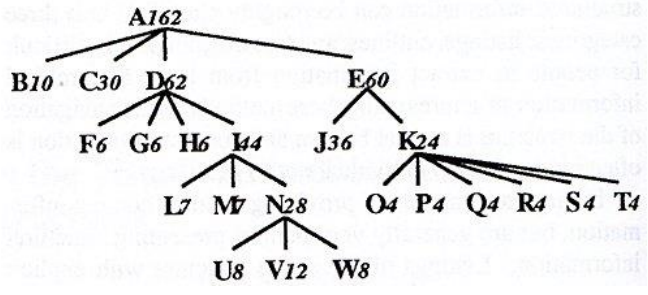
- Hierarchies often represented as trees
  - Directed, acyclic graph
- Two main representation schemes
  - Node-link
  - Space-filling

Node-Link Diagrams

- Root at top, leaves at bottom is very common



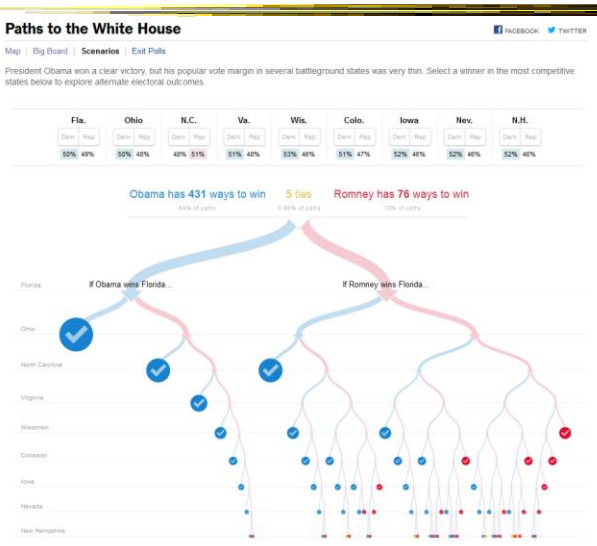
Sample Representation



From: Johnson & Shneiderman, '91

http://elections.nytimes.com/2012/results/president/scenarios

Election '12



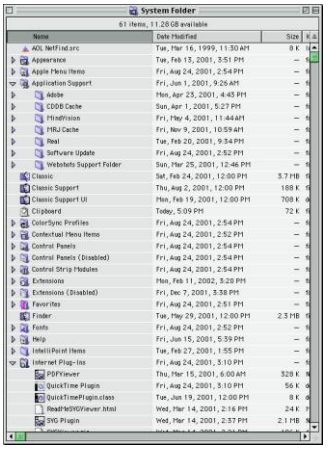
Examples

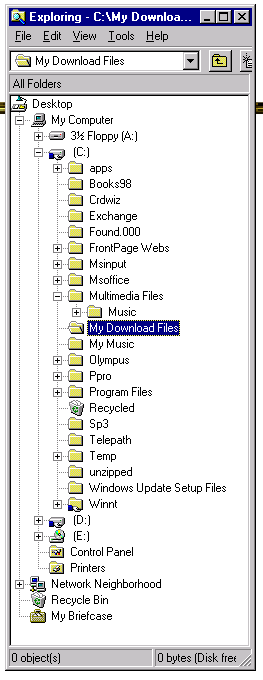
Good for?

Search

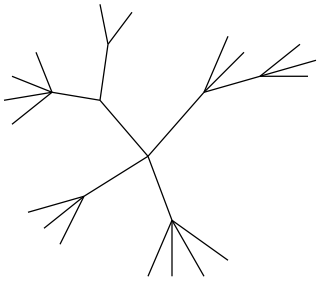
Bad for?

Understanding structure





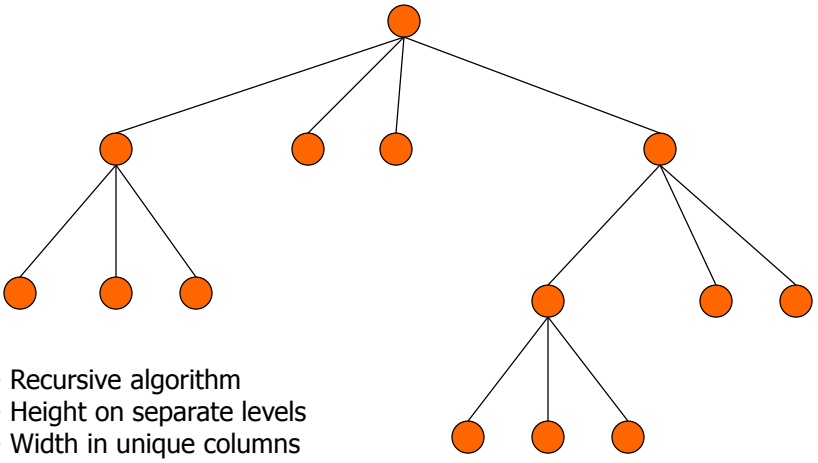
Why Put Root at Top?



Root can be at center with levels growing outward too

Can any node be the root?

Basic Algorithm

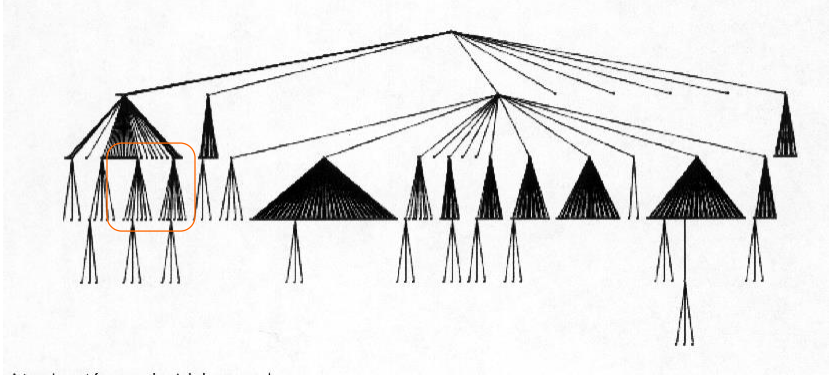


- Recursive algorithm
- Height on separate levels
- Width in unique columns
- Make room for subtrees upwards

Potential Problems

- For top-down, width of fan-out uses up horizontal real estate very quickly
  - At level n, there are 2^n nodes
- Tree might grow a lot along one particular branch
  - Hard to draw it well in view without knowing how it will branch

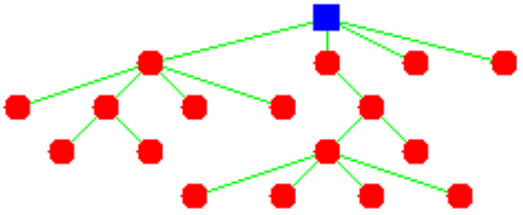
More Sophisticated



In what way?
- Regions compressed horizontally

Reingold-Tilford Algorithm

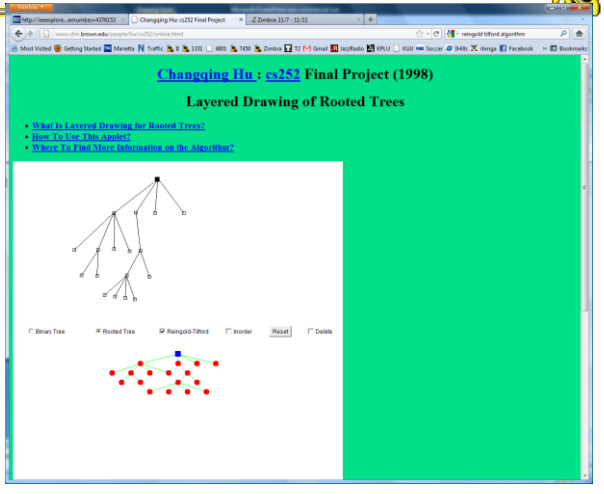
Compact layout
Uses symmetry
Depth on levels



Generalized from binary trees by Walker
Running time improved (linear) by Buchheim et al

Neat Applet

You do drawing
It cleans it up



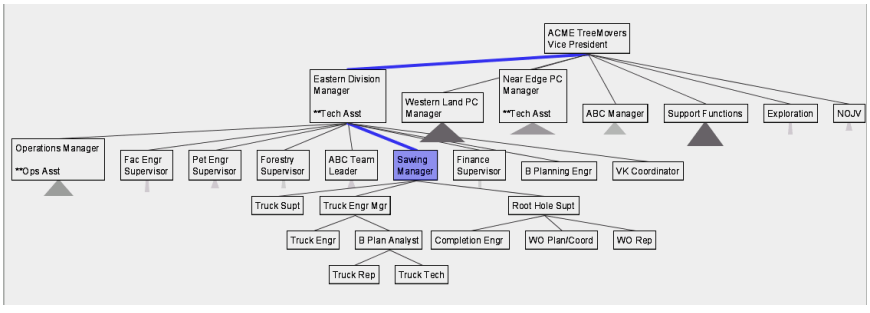
http://www.cfm.brown.edu/people/hu/cs252/online.html

InfoVis Solutions

- Techniques developed in Information Visualization largely try to assist the problems identified in the last slide
- Alternatively, Information Visualization techniques attempt to show more attributes of data cases in hierarchy or focus on particular applications of trees

SpaceTree

- Uses conventional 2D layout techniques with some clever additions



Video & Demo

Grosjean, Plaisant, Bederson
InfoVis '02

Characteristics

- Vertical or horizontal
- Subtrees are triangles
  - Size indicates depth
  - Shading indicates number of nodes inside
- Navigate by clicking on nodes
  - Strongly restrict zooming

Design Features

- Make labels readable
- Maximize number of levels opened
- Decompose tree animation
- Use landmarks
- Use overview and dynamic filtering

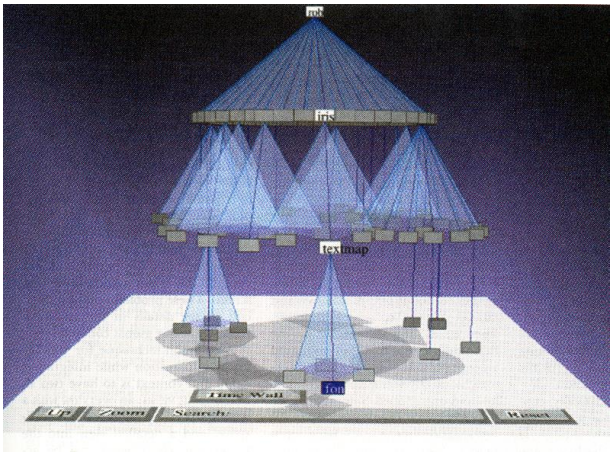
3D Approaches

- Add a third dimension into which layout can go
- Compromise of top-down and centered techniques mentioned earlier
- Children of a node are laid out in a cylinder "below" the parent
  - Siblings live in one of the 2D planes

Cone Trees

Developed at Xerox PARC

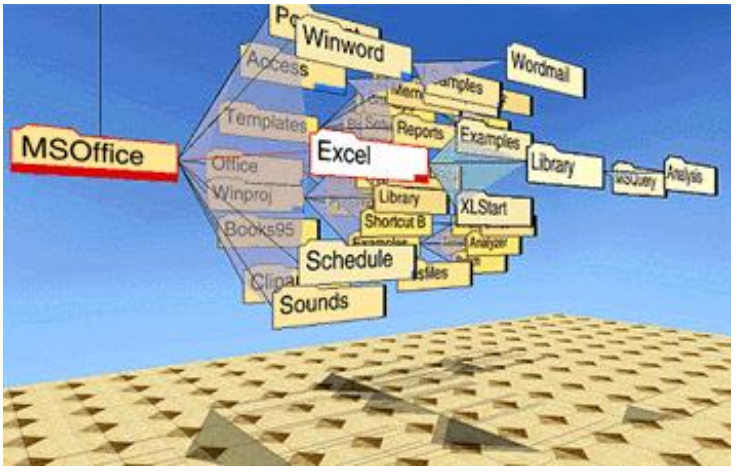
3D views of hierarchies such as file systems



Robertson, Mackinlay, Card CHI '91

Video

Alternate Views



Cone Trees

- Pros & Cons?
  - Discuss

Cone Trees

- Pros
  - More effective area to lay out tree
  - Use of smooth animation to help person track updates
  - Aesthetically pleasing
- Cons
  - As in all 3D, occlusion obscures some nodes
  - Non-trivial to implement and requires some graphics horsepower

Alternative Solutions

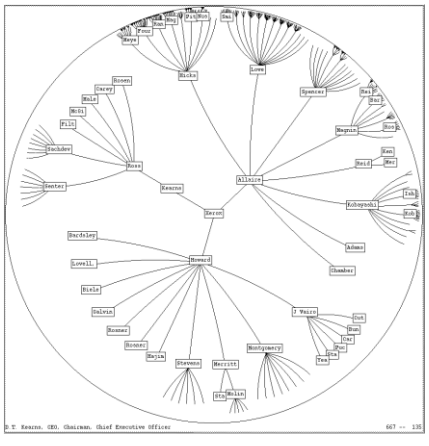
- Change the geometry
- Apply a hyperbolic transformation to the space
- Root is at center, subordinates around
- Apply idea recursively, distance decreases between parent and child as you move farther from center, children go in wedge rather than circle

Hyperbolic Browser

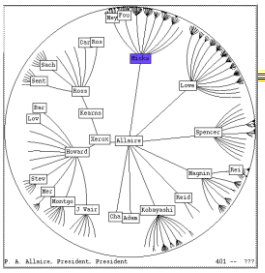
- Focus + Context Technique
  - Detailed view blended with a global view
- First lay out the hierarchy on the hyperbolic plane
- Then map this plane to a disk
- Start with the tree's root at the center
- Use animation to navigate along this representation of the plane

Lamping and Rao, JVLC '96

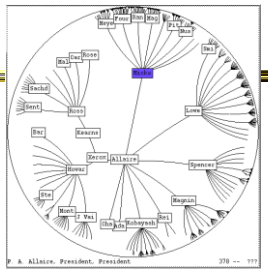
2D Hyperbolic Browser



- **Approach:** Lay out the hierarchy on the hyperbolic plane and map this plane onto a display region.
- **Comparison**
  - A standard 2D browser: 100 nodes (w/3 character text strings)
  - Hyperbolic browser: 1000 nodes, about 50 nearest the focus can show from 3 to dozens of characters



1



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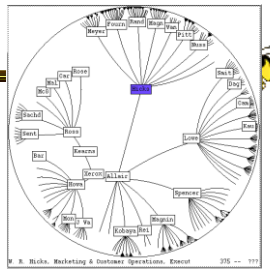

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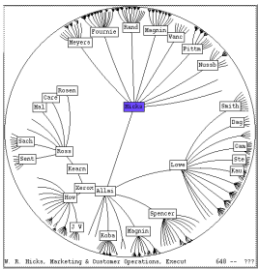

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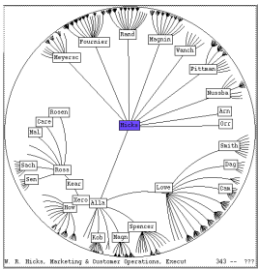


5

Clicking on the blue node brings it into focus at the center

Watch it Work

- Video
- Demo from prefuse system

Key Attributes

- Natural magnification (fisheye) in center
- Layout depends only on 2-3 generations from current node
- Smooth animation for change in focus
- Don't draw objects when far enough from root (simplify rendering)

Problems

- What might be problems with this approach?

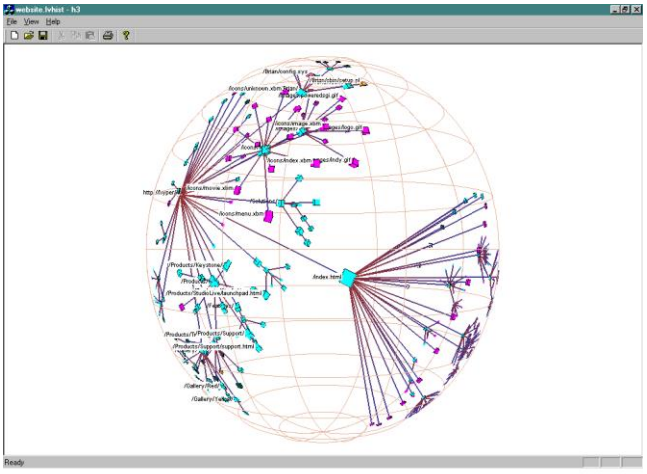
Problems

- Orientation
  - Watching the view can be disorienting
  - When a node is moved, its children don't keep their relative orientation to it as in Euclidean plane, they rotate
  - Not as symmetric and regular as Euclidean techniques, two important attributes in aesthetics

How about 3D?

- Can same hyperbolic transformation be applied, but now use 3D space?
- Sure can
- Have fun with the math!

H3Viewer



Munzner,
IEEE CG&A '98

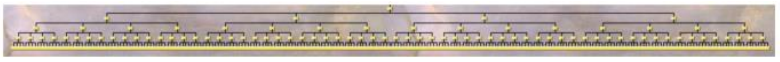
Video

Old School

- After all the interest in 3D and hyperbolic techniques in the '90's, more recently there has been renewed interest in the old 2D methods (just done better)
  - SpaceTree presented earlier
  - Next 3 papers…

Degree-of-Interest Trees

- Problem: Trees quickly degrade into line

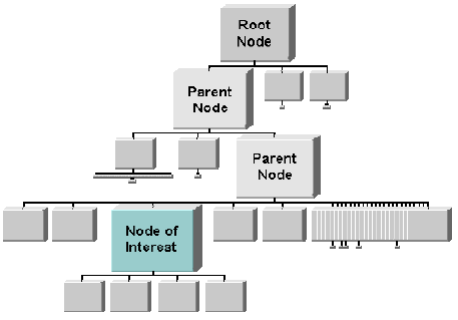


- Approach: Use fisheye-like focus & context ideas to control how a tree is drawn

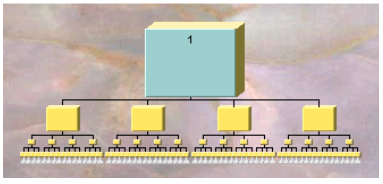
Card & Nation
AVI '02

Approach

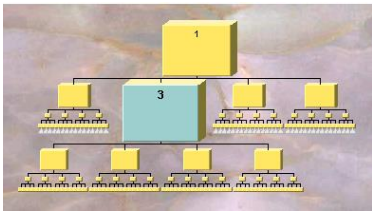
- Combine multiple ideas:
  - Expanded DOI computation
  - Logical filtering to elide nodes
  - Geometric scaling
  - Semantic scaling
  - Clustered representation of large unexpended branches
  - Animated transition



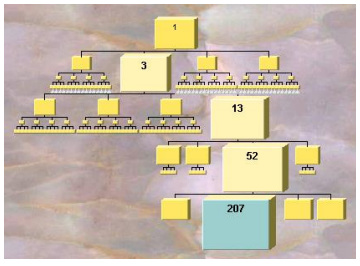
Example Operations



1. Display of a uniform tree of 4 levels



2. Same table with focus on Node 3

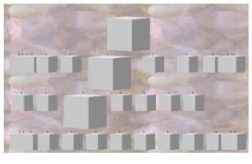


3. Same tree expanded down to a leaf node

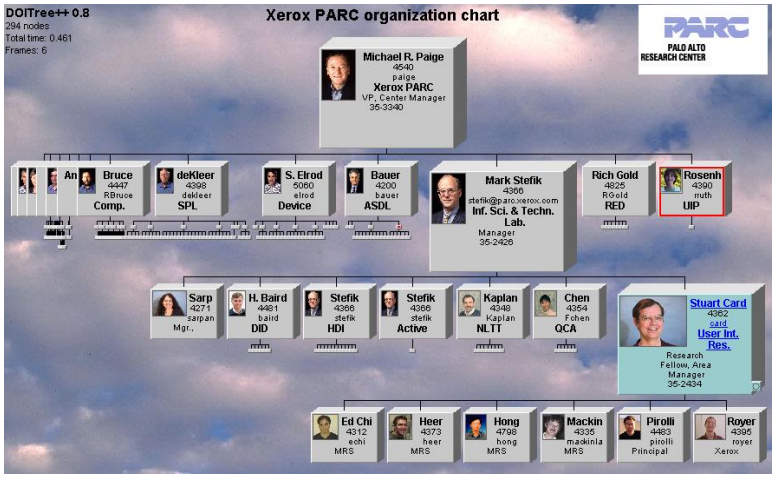
Compression

- For nodes: compress to fit (compress in X or in Y)

- Within-node compression
  - Data deletion
  - Word abbreviation
  - Node rotation



Better View of Org Chart



Organization chart with over 400 nodes accessible over WWW through Web browser

Food for Thought

- Which of these techniques are useful for what purpose?
- How well do they scale?
- What if we want to portray more variables of each case?

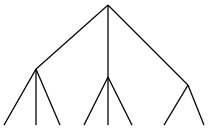
Node-link Shortcoming

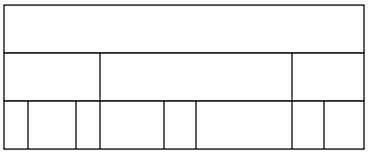
- Difficult to encode more variables of data cases (nodes)
  - Shape
  - Color
  - Size
  - …but all quickly clash with basic node-link structure

Space-Filling Representation

Each item occupies an area

Children are "contained" under parent



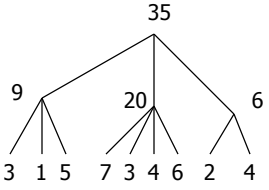


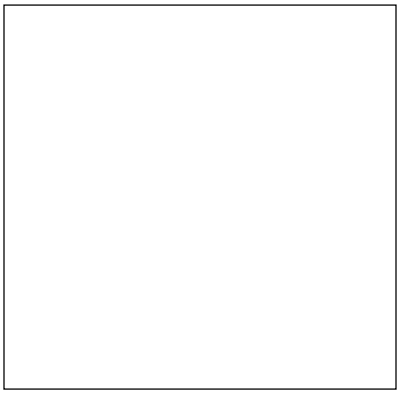
One example: "Icicle plot"

Treemap

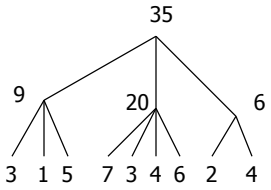
- Space-filling representation developed by Shneiderman and Johnson, Vis '91
- Children are drawn inside their parent
- Alternate horizontal and vertical slicing at each successive level
- Use area to encode other variable of data items

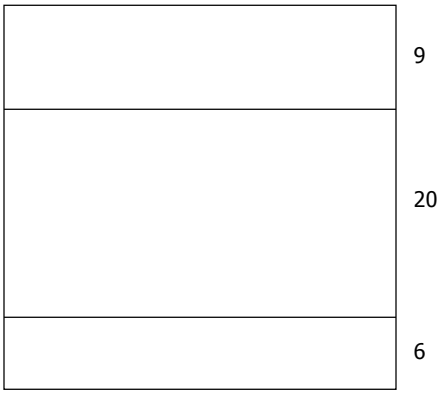
Example



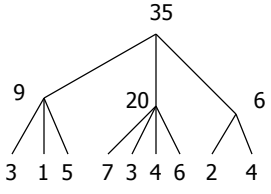


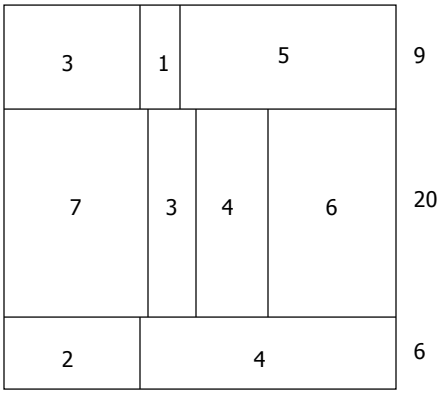
Example





Example



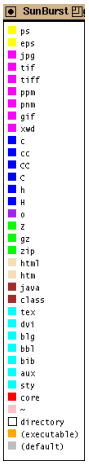


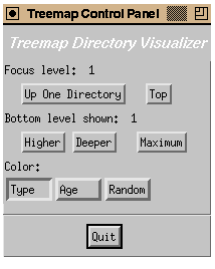
Treemap

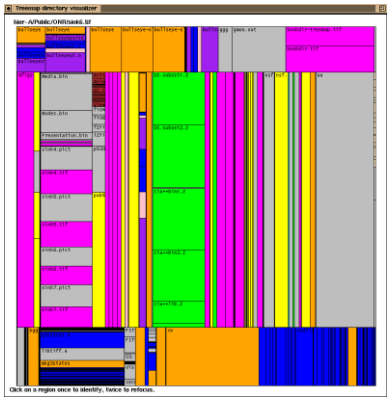
- Example

Directories

Treemap Example





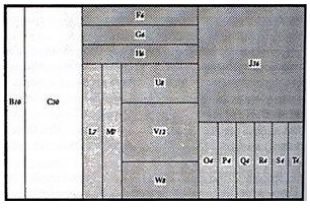


Old one I built for our Sun workstations

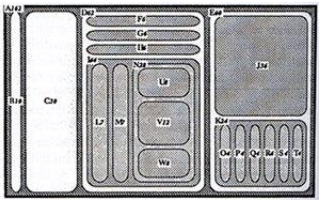
Treemap Algorithm

```
Draw()
{
   Change orientation from parent (horiz/vert)
   Read all files and directories at this level
   Make rectangle for each, scaled to size
   Draw rectangles using appropriate size and color
   For each directory
      Make recursive call using its rectangle as focus
}
```

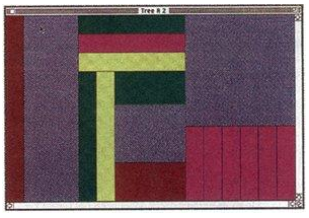

Nested vs. Non-nested



Non-nested Tree-Map



Nested Tree-Map



Applications

- Can use Treemap idea for a variety of domains
  - File/directory structures
  - Basketball statistics
  - Software diagrams
  - Tennis matches

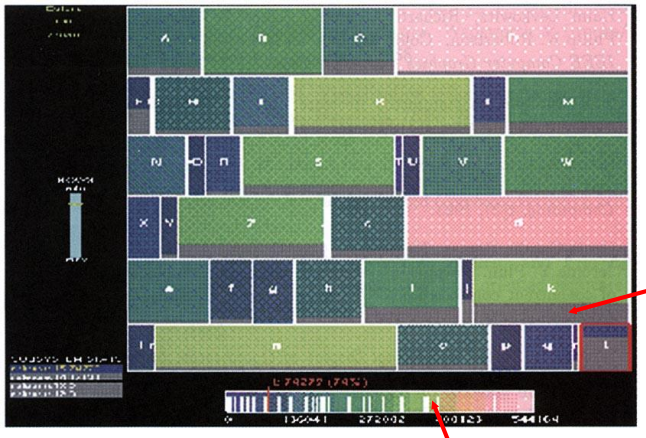
Software Visualization App

- SeeSys: Software Metrics Visualizing System
- Uses treemap-like visualization to present different software metrics
- Displays:
  - Size
  - Recent development
  - High fix-on-fix rates
  - History and growth

Baker and Eick
JVLC '95

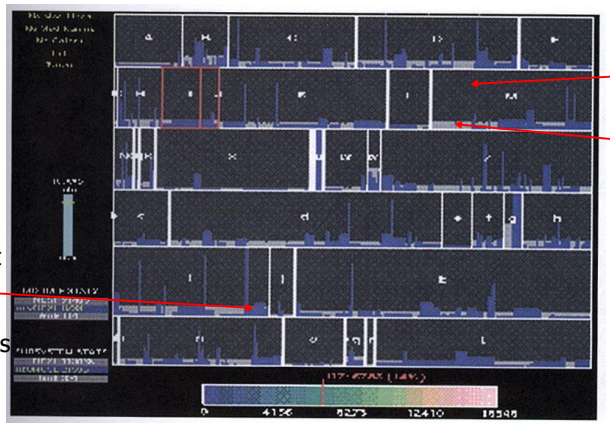
Sample View 1

Subsystems in a software system. Each rectangle represents the non-comment source code in a subsystem. Area means size



Sample View 2

Bug rates by subsystem and directory

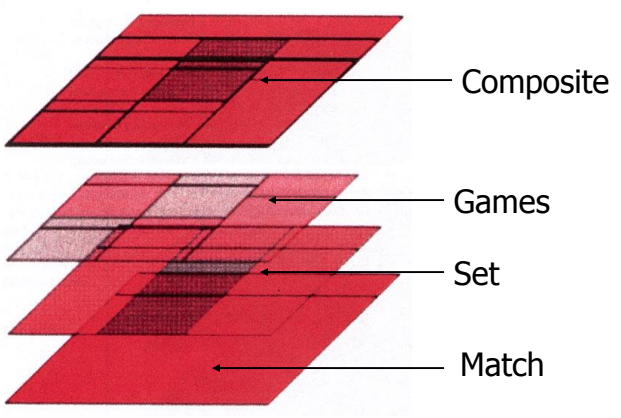


Tennis Viewing Application

- Analyze, review and browse a tennis match
- Space-filling/treemap-like hierarchy representation for a competition tree
- Shows match,sets,games,points
- Uses lenses to show shot patterns
- Red/green to encode two players
- Composite colors on top of each other

Jin and Banks
IEEE CG&A '97

Visualization Make-up



Simulated Match Results

Match view

Bond won

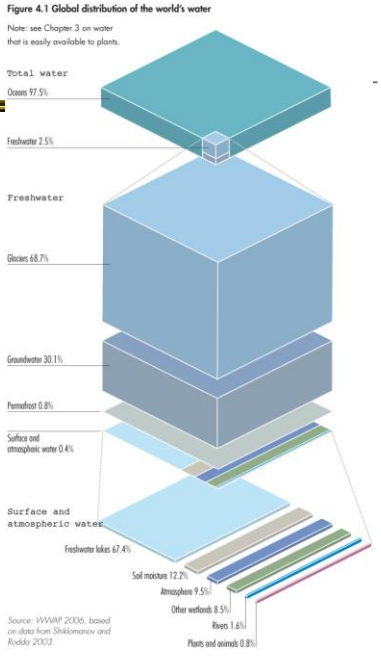
Set results

Lens showing ball movement on individual points

Game results

Treemap?

Very nice infographic

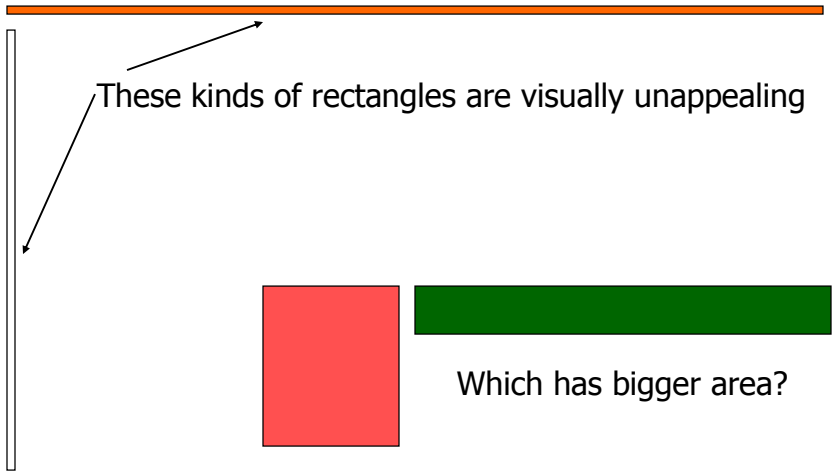


http://blog.wired.com/wiredscience/2008/06/awesome-infogra.html

Treemap Affordances

- Good:
  - Representation of two attributes beyond node-link: color and area
- Not so good:
  - Representing structure
    - What happens if it's a perfectly balanced tree of items all the same size?
    - Also can get long-thin aspect ratios
    - Borders help on smaller trees, but take up too much area on large, deep ones

Aspect ratios



Variation

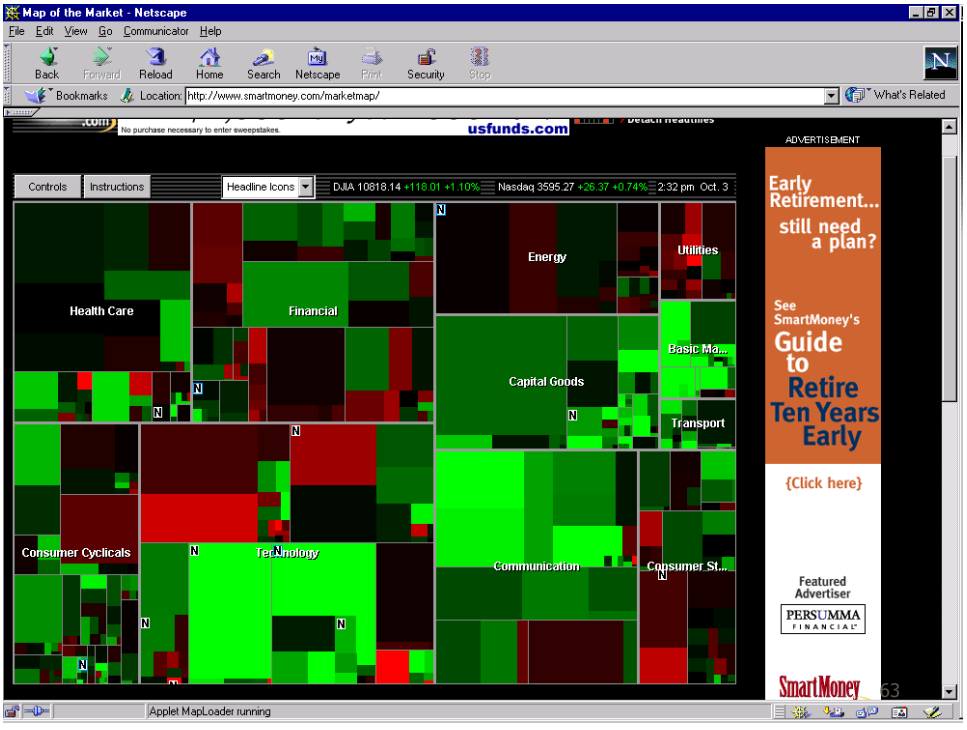
- Can rectangles be made more square? ……think about it……
- In general, a very hard problem!

Variation: "Cluster" Treemap

- SmartMoney.com Map of the Market
  - Illustrates stock movements
  - "Compromises" treemap algorithm to avoid bad aspect ratios
  - Basic algorithm (divide and conquer) with some hand tweaking
  - Takes advantage of shallow hierarchy
  - `www.smartmoney.com/marketmap`

Image on next slide

Wattenberg CHI '99


Map of the Market - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Stop
Bookmarks Location: http://www.smartmoney.com/marketmap/
What's Related
usfunds.com
ADVERTISEMENT
Early Retirement... still need a plan?
See SmartMoney's Guide to Retire Ten Years Early
{Click here}
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Headline Icons
DJIA 10818.14 +118.01 +1.10%
Nasdaq 3595.27 +26.37 +0.74%
2:32 pm Oct. 3
Health Care
Financial
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Utilities
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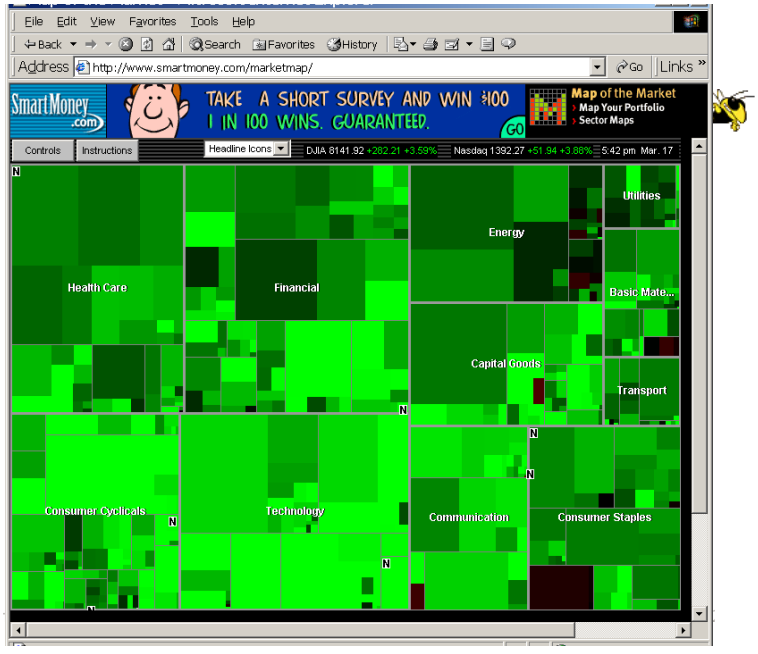
Capital Goods
Transport
Consumer Cyclicals
Technology
Communication
Consumer St...
Applet MapLoader running

A good day :^)


File Edit View Favorites Tools Help
Back Search Favorites History
Address http://www.smartmoney.com/marketmap/
Go Links
SmartMoney.com
TAKE A SHORT SURVEY AND WIN $100
1 IN 100 WINS. GUARANTEED.
GO
Map of the Market
Map Your Portfolio
Sector Maps
Controls
Instructions
Headline Icons
DJIA 8141.92 +282.21 +3.59%
Nasdaq 1392.27 +51.94 +3.88%
5:42 pm Mar. 17
Health Care
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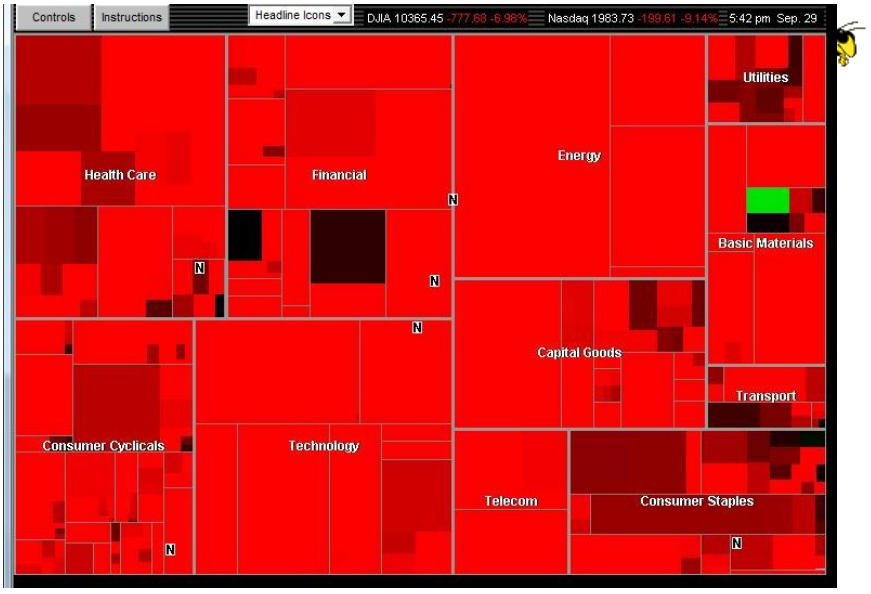
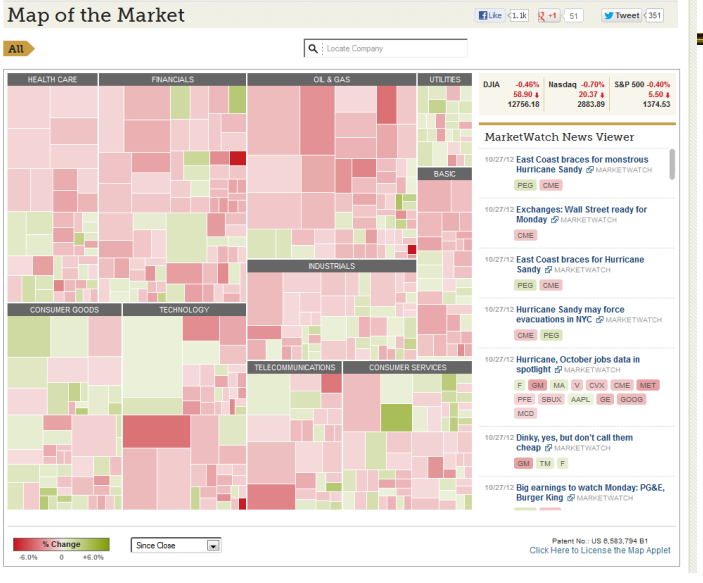
Transport
Consumer Cyclicals
Technology
Communication
Consumer Staples

More recent times Sept. 29, 2008



New One



I don't like it as much

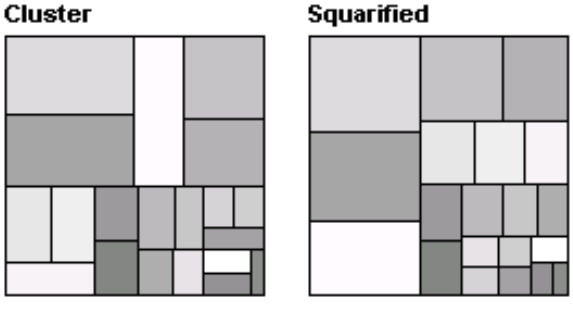
(Where's the nice control panel?)

SmartMoney Review

- Tufte-esque micro/macro view
- Dynamic user interface operations add to impact
- One of best applications of an InfoVis techniques that I've seen

Other Treemap Variations

- Squarified treemap
  - Bruls, Huizing, van Wijk, EuroGraphics '00
  - Alternate approach, similar results



Square Algorithm Problems

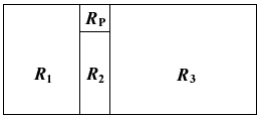
- Small changes in data values can cause dramatic changes in layout
- Order of items in a group may be important

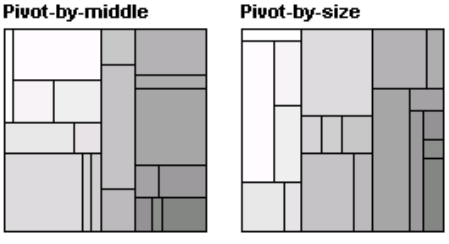
New Square Algorithms

- Pivot-by-size and pivot-by-middle

Partition area into 4 regions
Pick pivot element Rp
  Size: Largest element
  Middle: Middle element
R_1 - elements earlier in list than pivot
R_2 - elements in list before R_3 and also that makes Rp have aspect ratio closest to 1

Shneiderman & Wattenberg
InfoVis '01



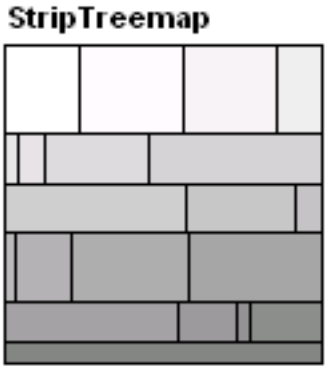


New Variation

- Strip treemap

Use strips to place items

Put new rectangle into strip
If it makes average aspect ratio of all rectangles in strip go down, keep it there
If it makes aspect ratio go up, put it back and move to next strip



Bederson, Shneiderman & Wattenberg
ACM Trans on Graphics '02

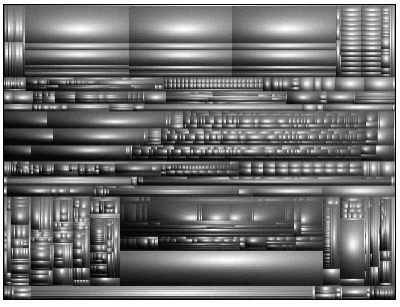
Showing Structure

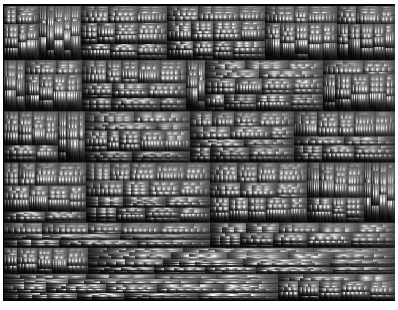
- Regular borderless treemap makes it challenging to discern structure of hierarchy, particularly large ones
  - Supplement Treemap view
  - Change rectangles to other forms

Variation: Cushion Treemap

Add shading and texture to help convey structure of hierarchy

Van Wijk & van de Wetering
InfoVis '99

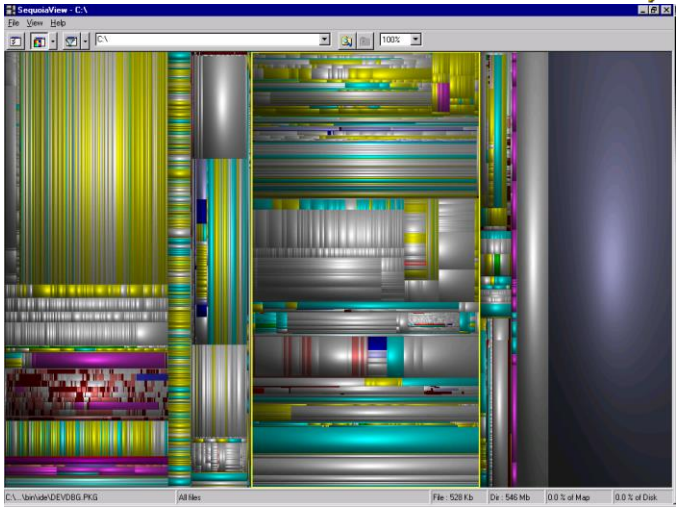




SequoiaView

www.win.tue.nl/sequoiaview/

File visualizer built using cushion treemap notion

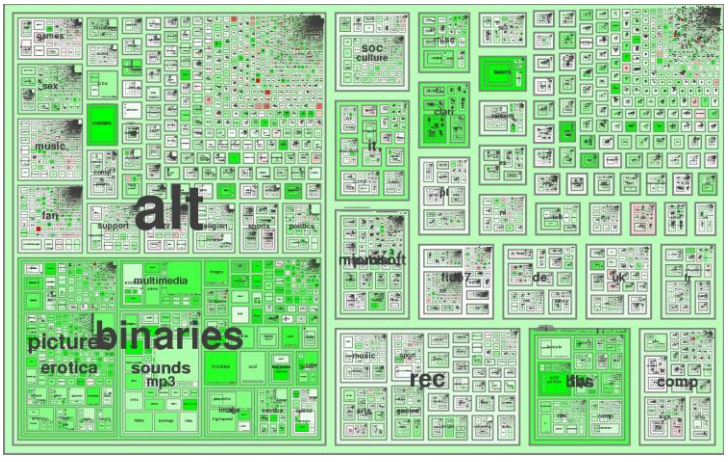


Demo

Internet News Groups

NetScan

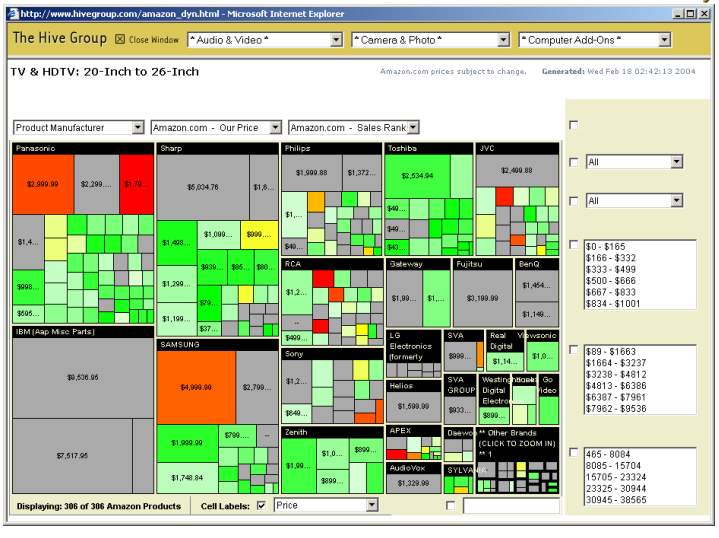
Fiore & Smith
Microsoft



Product Sales

www.hivegroup.com/amazon.html

The Hive Group



News Stories

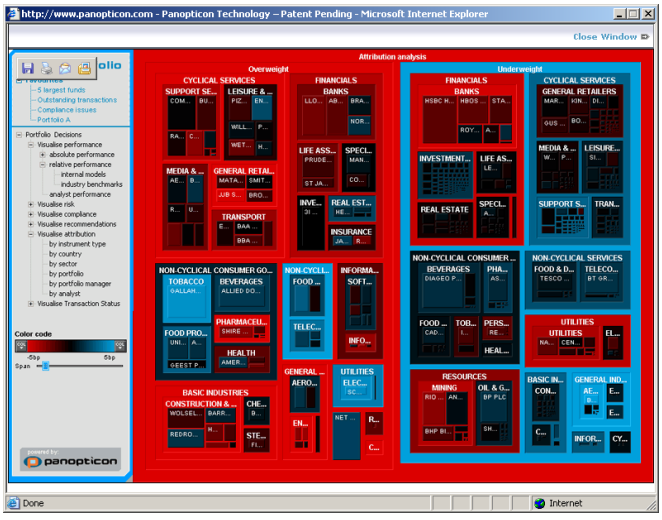
www.marumushi.com/apps/newsmap/newsmap.cfm

Marumushi

Investment Portfolios

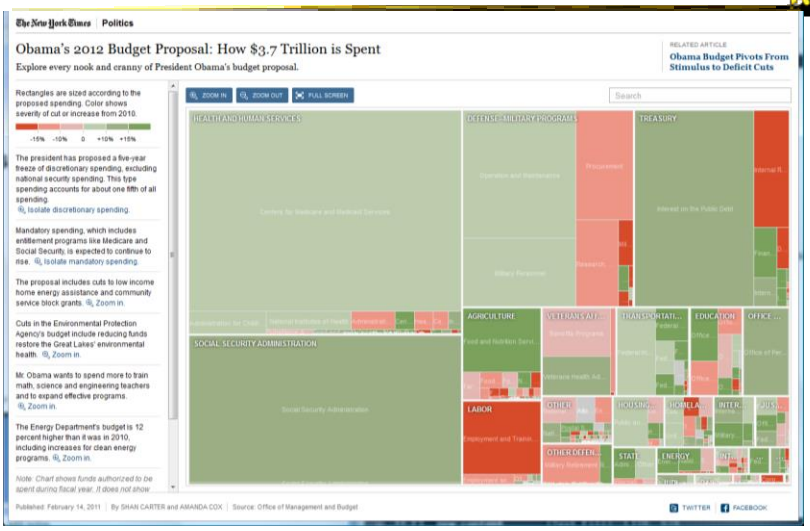
www.panopticon.com

Panopticon

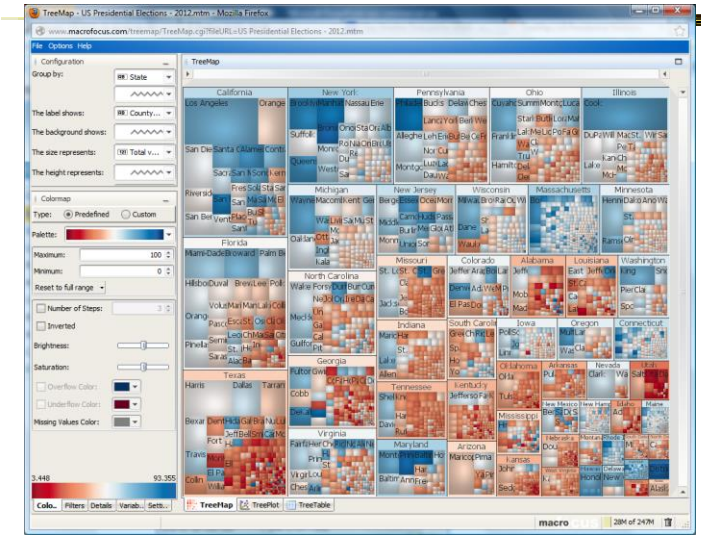


www.nytimes.com/packages/html/newsgraphics/2011/0119-budget/

Federal Budget



2012 Presidential Election



http://www.treemap.com/datasets/uselections/?goback=.gde_80552_member_184123140

Scaling Up

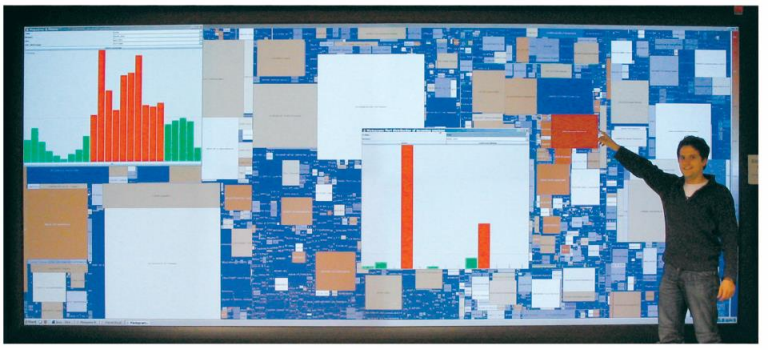
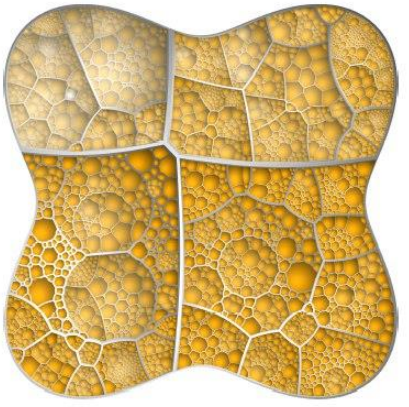
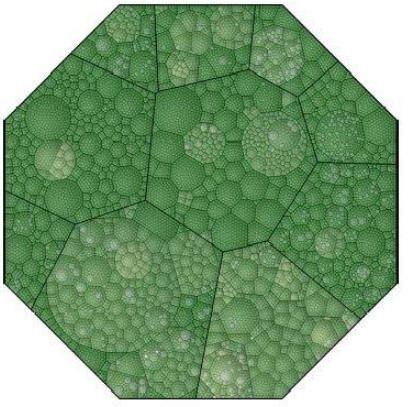


Fig. 5. *Hierarchical Network Map* displaying all 19,731 autonomous systems (one can still zoom in twice for details) on a large display wall (5.20m × 2.15m, 8.9 Megapixels, powered by eight projectors). The query interface on the top left shows the traffic distribution over time and specifies the selected data, in this case the traffic entering the gateway of the University of Konstanz on *well-known ports (0-1023)* on 29 November 2005 using "transferred bytes" as measure with logarithmic color mapping. One recognizes a heavy traffic load from AS 3320 (red) of "Deutsche Telekom" as well as to neighboring autonomous systems in Germany. A port histogram reveals high activity on the Web ports 80 and 443. For security and privacy reasons, the data was aggregated and sanitized.

Mansmann & Vinnik
TVCG '06

Voronoi Treemaps





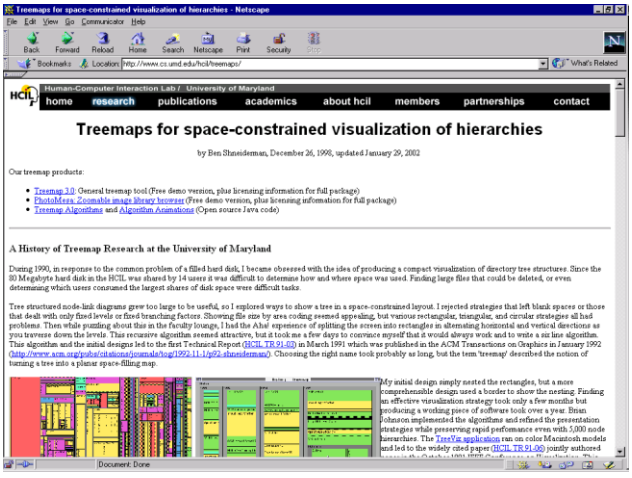
Balzer & Deussen
InfoVis '05

www.cs.umd.edu/hcil/treemap-history/

The World of Treemaps

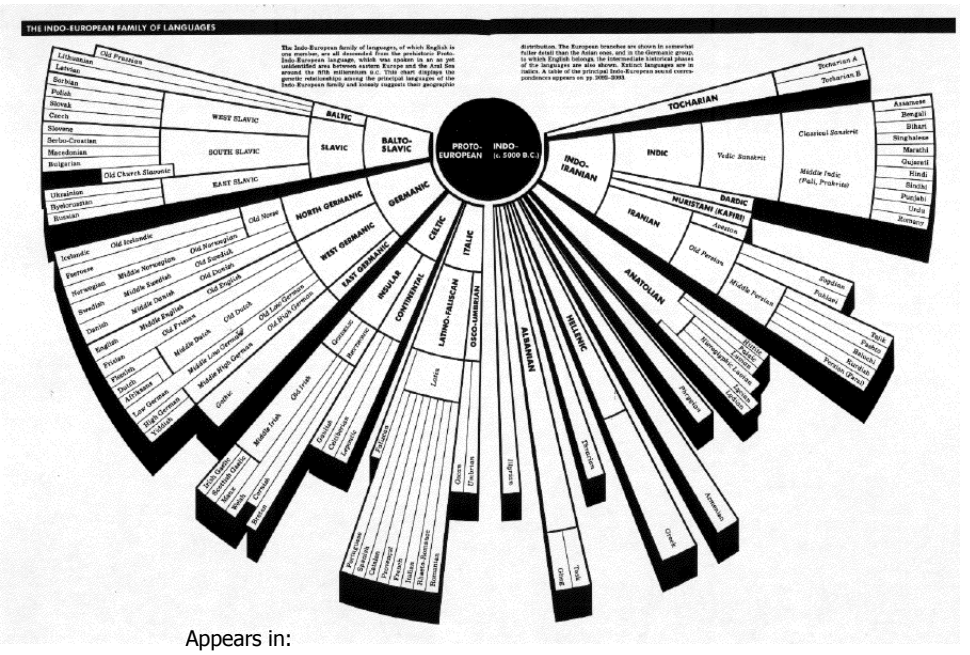
Maryland HCIL website devoted to Treemaps

Workshop in 2001 there on topic



Another Technique

- What if we used a radial rather than a rectangular space-filling technique?
  - We saw node-link trees with root in center and growing outward already...
- Make pie-tree with root in center and children growing outward
  - Radial angle now corresponds to a variables rather than area

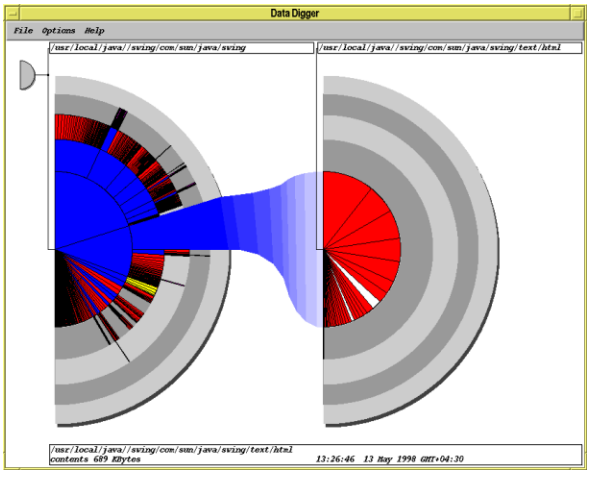


Appears in:
American Heritage Dictionary, 3rd Ed. Houghton Mifflin, 1992

Radial Space-Filling

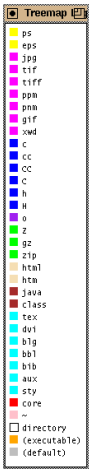
Chuah
InfoVis '98

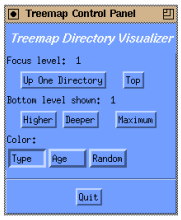
Andrews &
Heidegger
InfoVis '98



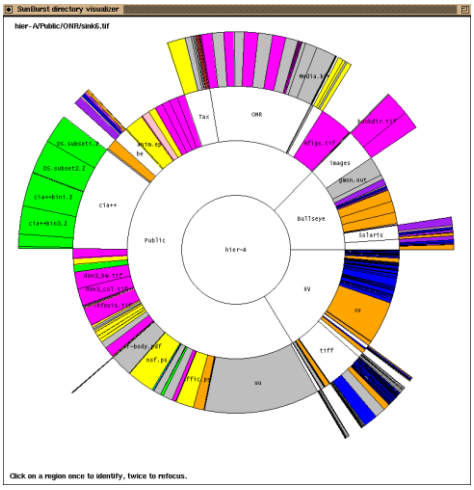
SunBurst

Stasko, Catrambone, Guzdial & McDonald
IJHCS '00





Demo

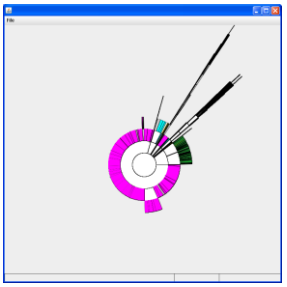


SunBurst

- Root directory at center, each successive level drawn farther out from center
- Sweep angle of item corresponds to size
- Color maps to file type or age
- Interactive controls for moving deeper in hierarchy, changing the root, etc.
- Double-click on directory makes it new root

SunBurst

- Demonstration of system



Java version built by Neel Parekh

Empirical Study

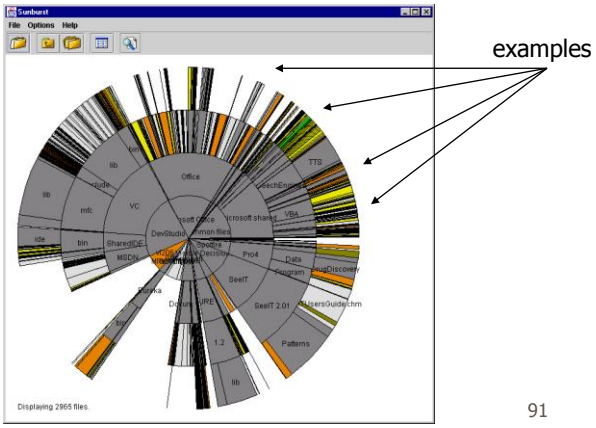
Stasko, Catrambone, Guzdial & McDonald
IJHCS '00

- Compared SunBurst to Treemap (borderless) on a variety of file browsing tasks
  - SunBurst performed as well (or better) in task accuracy and time
  - Learning effect - Performance improved with Treemap on second session
  - Strong subjective preference (51-9) for SunBurst
  - Participants cited more explicit depiction of structure as an important reason

More to come on evaluation...

SunBurst Negative

- In large hierarchies, files at the periphery are usually tiny and very difficult to distinguish



Fix: Objectives

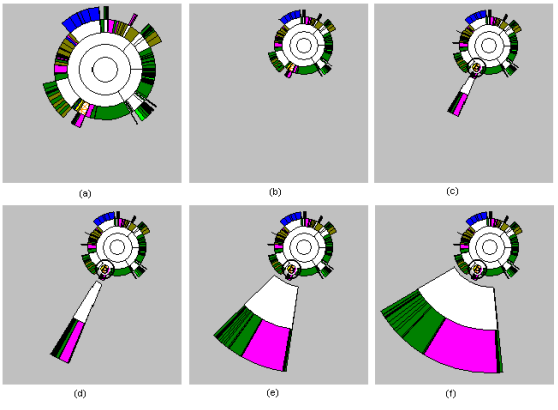
- Make small slices bigger
- Maintain full circular space-filling idea
- Allow detailed examination of small files within context of entire hierarchy
- Don't alter ratios of sizes
- Avoid use of multiple windows or lots of scrollbars
- Provide an aesthetically pleasing interface in which it is easy to track changes in focus

3 Solutions

- Three visualization+navigation techniques developed to help remedy the shortcoming
  - Angular detail
  - Detail outside
  - Detail inside

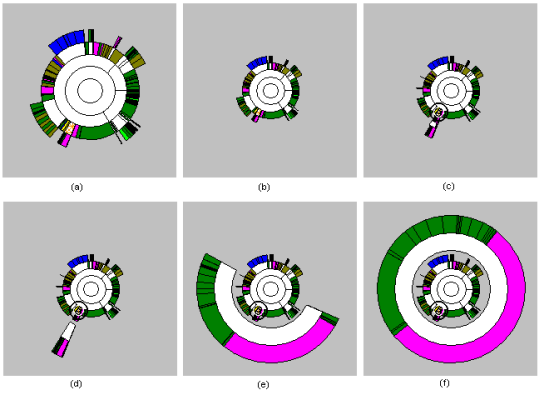
Stasko & Zhang
InfoVis '00

Angular Detail



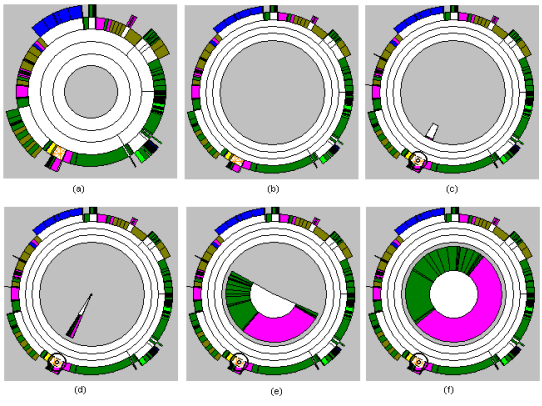
- Most "natural"
- Least space-efficient
- Most configurable by user

Detail Outside



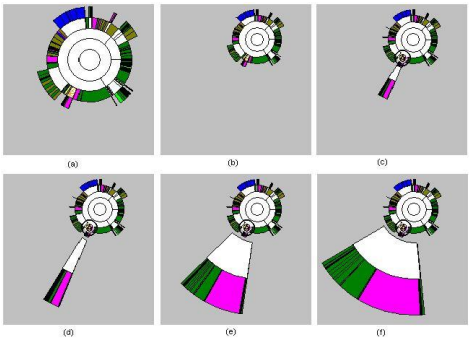
- Exhibits non-distorted miniature of overview
- Somewhat visually disconcerting
- Focus is quite enlarged (large circumference and 360°)
- Relatively space efficient

Detail Inside



- Perhaps least intuitive and most distorting
- Items in overview are more distinct (larger circumference)
- Interior 360° for focus is often sufficient

See in Action



Video

Stasko & Zhang
InfoVis '00

Key Components

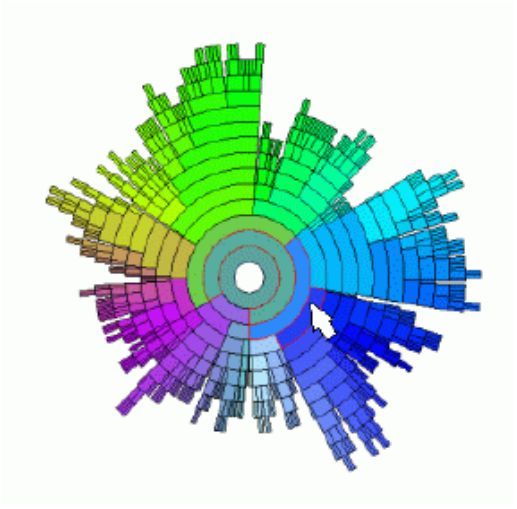
- Two ways to increase area for focus region: larger sweep angle and longer circumference
- Smooth transitions between overview and focus allow viewer to track changes
- Always display overview
- Allow focus selections from anywhere: normal display, focus or overview regions

Potential Follow-on Work

- Multiple foci
- Varying radii for different levels in hierarchy
- Use quick-keys to walk through neighboring files
- Smarter update when choosing new focus region from existing focus
- Fourth method: expand angle of focus in place by compressing all others

InterRing

Provides many of those follow-on capabilities and new operations

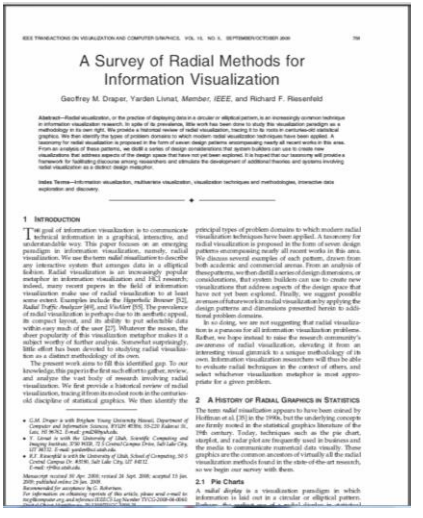


Yang, Ward & Rudensteiner InfoVis '02

Even Sand Crabs Do It

http://www.flickr.com/photos/jkr1812/2234846316/in/gallery-49563472@N07-72157624817856060/lightbox/

Survey of Radial Techniques



A Survey of Radial Methods for Information Visualization

Geoffrey M. Draper, Yarden Livnat, Member, IEEE, and Richard F. Riesenfeld

Draper et al
TVCG '09

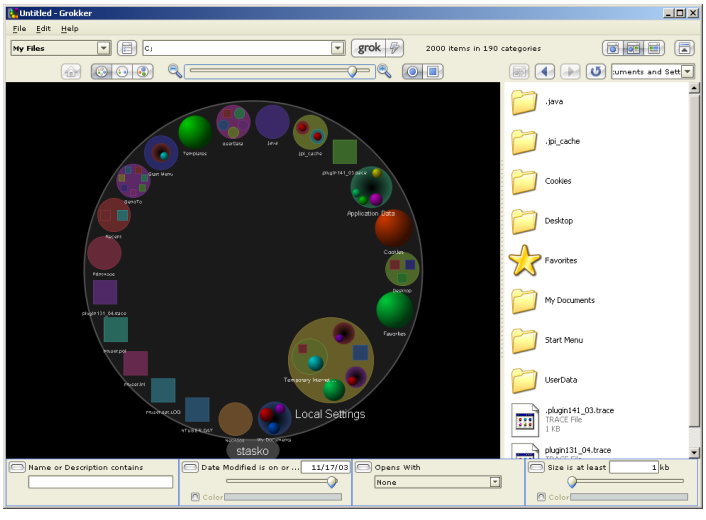
More Alternatives

- Combine space-filling hierarchy presentations (really nesting) with zooming
- Children drawn inside of parent, but not totally encompassing

Grokker

www.groxis.com

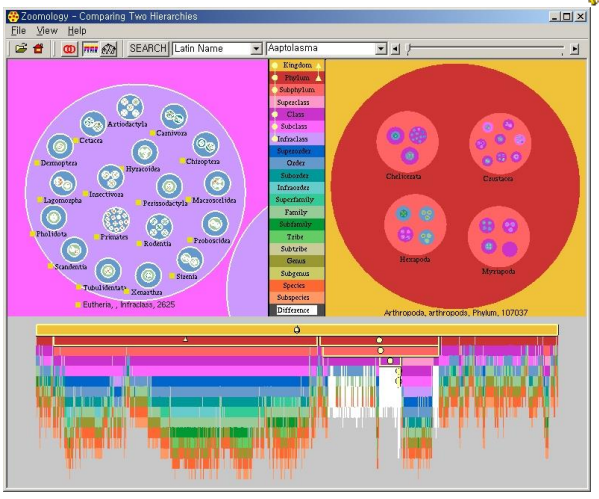
Demo



Zoomology

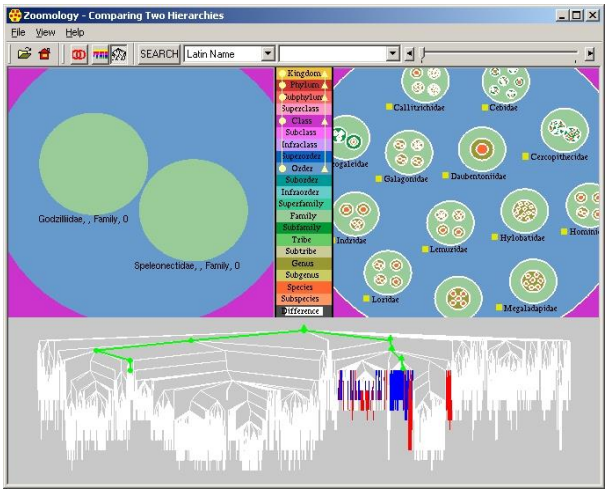
CS 7450
Spring '03
project

InfoVis '03
Contest Winner
Best Student
entry



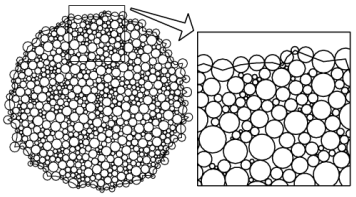
Alternate View

Video



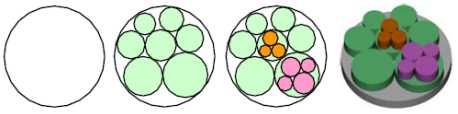
Circle Packing

Wang, Wang, Dai & Wang
CHI '06



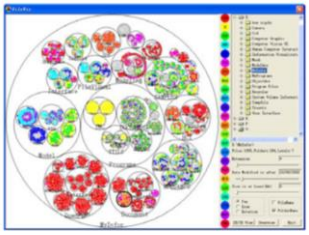
(a) (b)

Figure 4. Packing 1000 circles with random radii

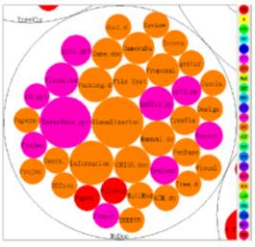


(a) Level 0 (b) Level 1 (c) Level 2 (d) 3D view

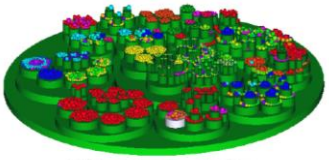
Figure 5. Pack circles into a circle recursively



(a) User interface and the overview of "D:\MyInfor"



(b) The details of the focus "MyInfor\Document\MyDoc"

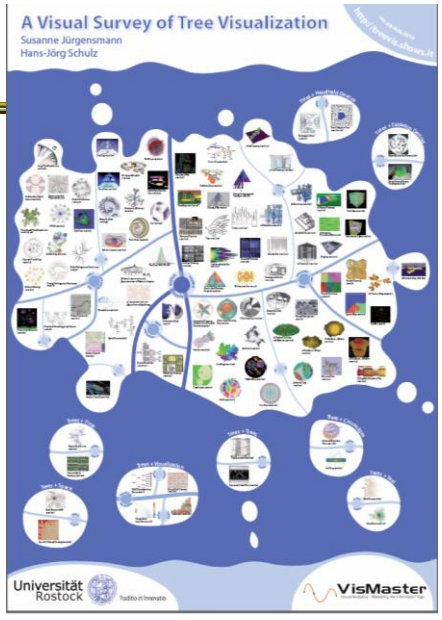


(c) 3D nested cylinders and spheres

Summary

- Node-link diagrams or space-filling techniques?
- It depends on the properties of the data
  - Node-link typically better at exposing structure of information structure
  - Space-filling good for focusing on one or two additional variables of cases

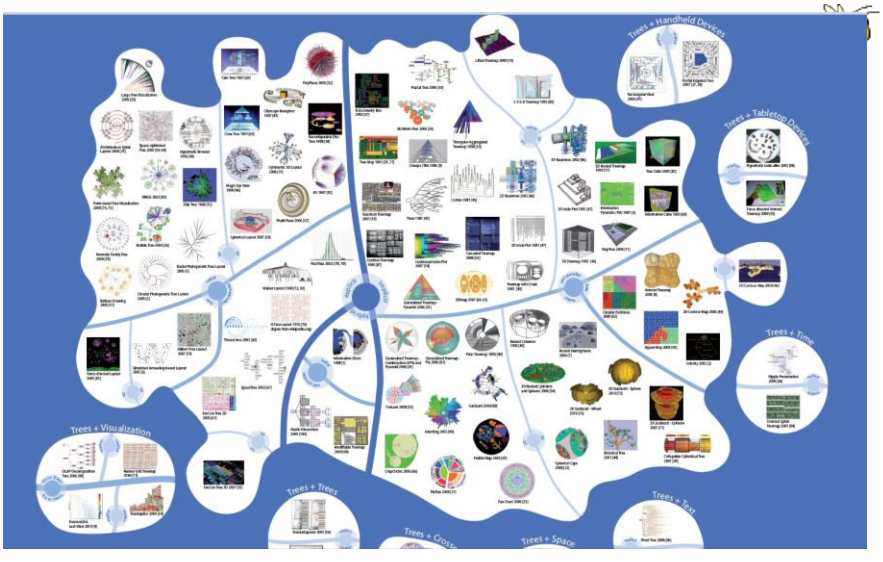
Great Visual Summary



Downloadable poster

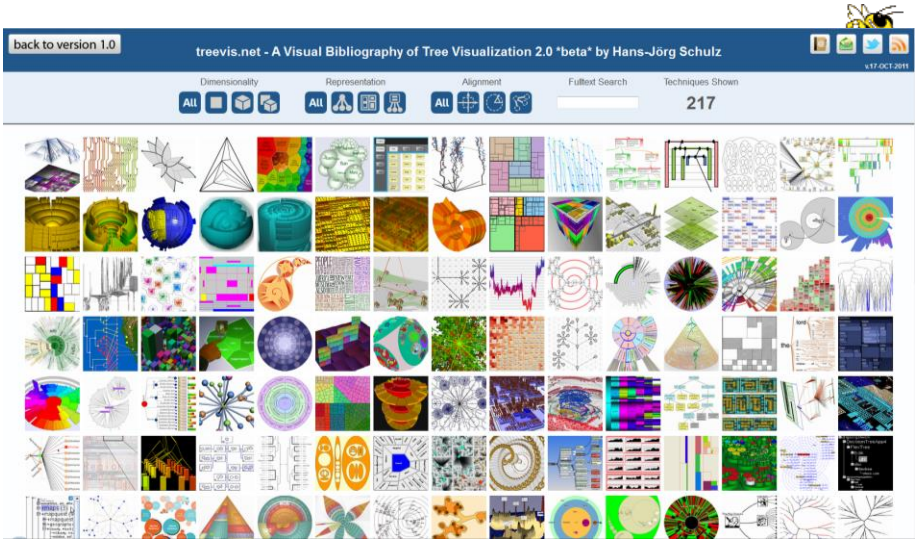
http://www.informatik.uni-rostock.de/~hs162/treeposter/oldposter/poster.html

Zoomed In



Version 2

http://treevis.net



HW 6

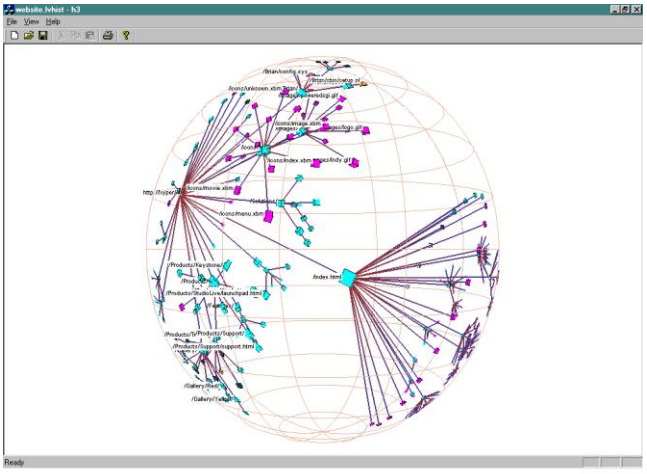
- Given a set of reviews of a particular TV from Amazon
- Design a visualization to that allows someone to explore the data from those reviews
  - Just do drawings on paper
- Due next Thursday, 30th

Upcoming

- Text and Documents 1
  - Reading
- Text and Documents 2
  - Reading

Additional Material

H3Viewer



Munzner,
IEEE CG&A '98

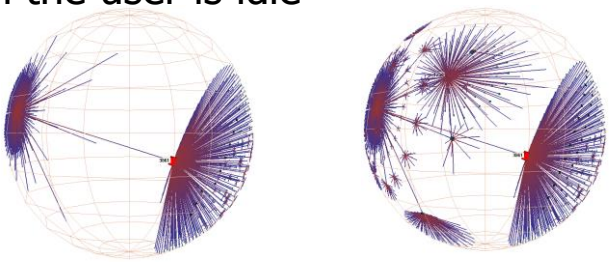
Video

Layout

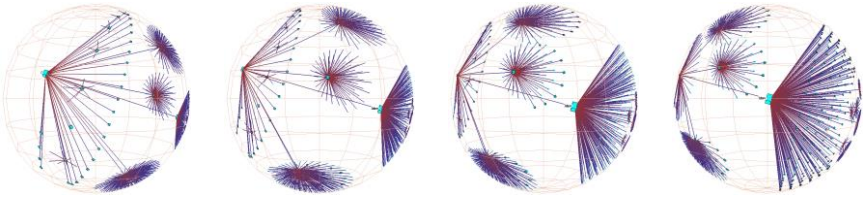
- Find a spanning tree from an input graph
  - Use domain-specific knowledge
- Layout algorithm
  - Nodes are laid out on the surface of a hemisphere
  - A bottom-up pass to estimate the radius needed for each hemisphere
  - A top-down pass to place each child node on its parental hemisphere's surface

Drawing

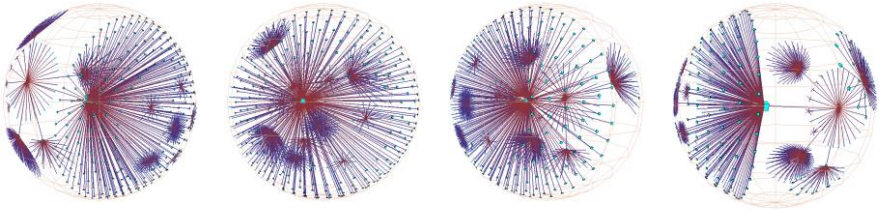
- Maintain a target frame by showing less of the context surrounding the node of interest during interactive browsing
- Fill in more of the surrounding scene when the user is idle



Navigation



Translation of a node to the center



Rotation around the same node

Performance

- Handle much larger graphs, i.e. >100,000 edges
- Support dynamic exploration & interactive browsing
- Maintain a guaranteed frame rate

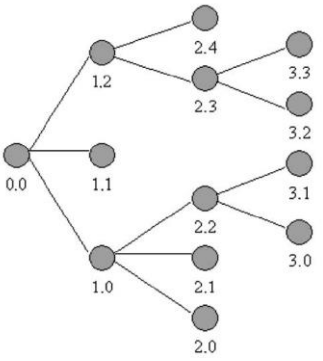
http://graphics.stanford.edu/~munzner/

FlexTree

- Horizontally-drawn tree with compression along vertical dimension
- One focus is on showing decision trees well
- Contextual multi-foci view
- Basic idea: Push all nodes down as far as you can

Song, Curran & Sterritt
Information Visualization '04

Example



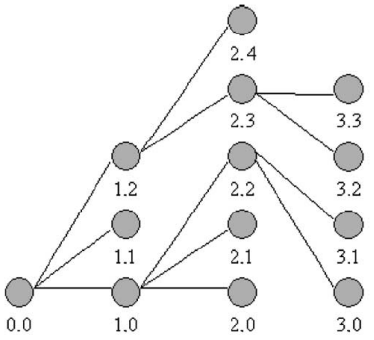


Figure 3 Concept diagram of FlexTree – space between nodes is compressed to achieve a compact view.

Bar Chart and Partial Views

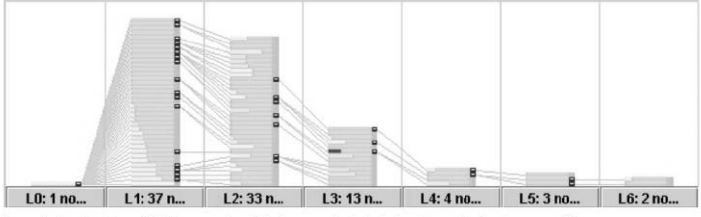


Figure 4 *Bar chart view* of FlexTree – nodes within the same level stack closely to each other in a space-filling manner.

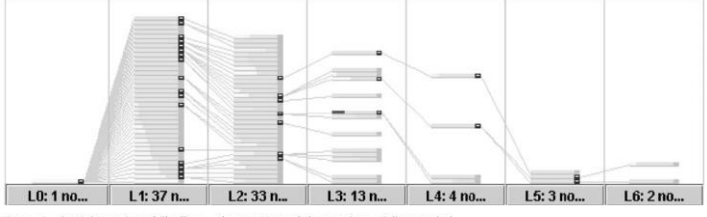


Figure 5 *Partial tree view* of FlexTree – the structure of the tree is partially revealed.

Full Tree View

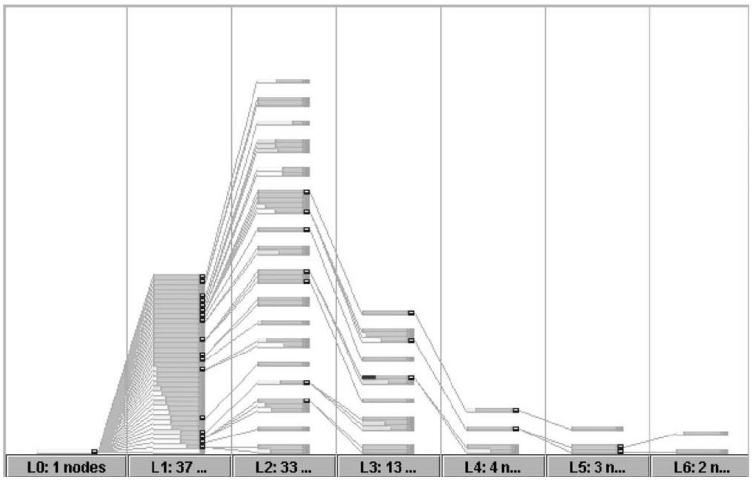


Figure 6 *Full tree view* of FlexTree – the structure of the tree is fully revealed.

Node Details

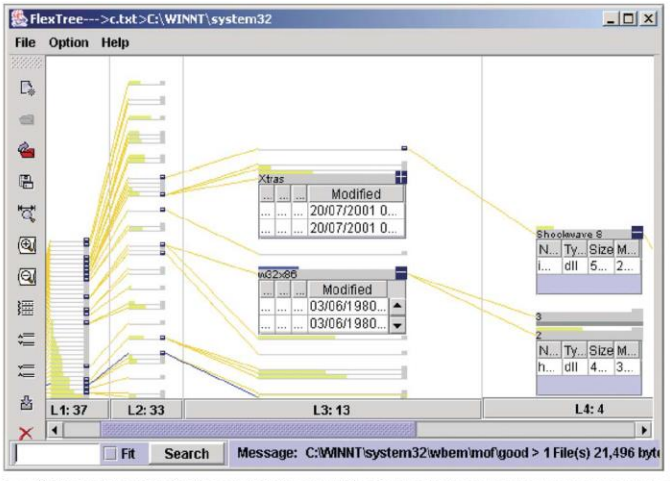


Figure 9 Zooming into multiple foci of interest within the context of the hierarchy. This demonstrates how the user can zoom into a tree and generate details on demand. The *w32 × 86* node itself is shown in blue, rather than yellow as the other nodes, because all files in this folder were modified in 1980, which is much earlier than files in the other folders.

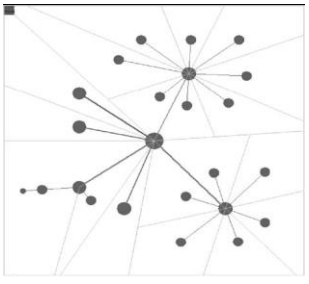
Space-Optimized Tree

- Put root node at center, then draw children out radially
- Key: Smart positioning to optimize placement of braches (Voronoi diagram-like approach)

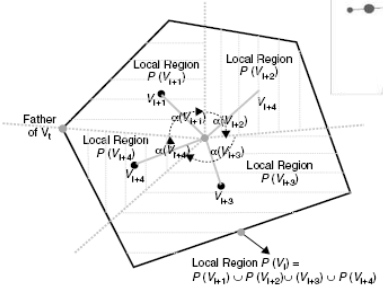
Nguyen & Huang
Information Visualization '03

Space-optimized tree

- Connections + Enclosures
  - Goal: Show relationships and optimize space

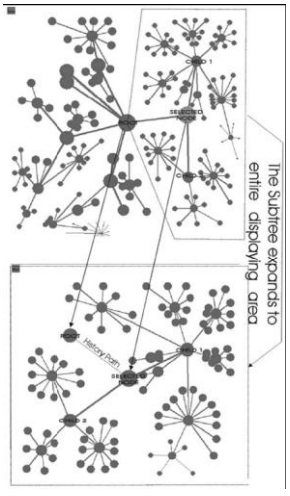


- Layout
  - Vertex
  - Subtree
  - Wedge
  - Polygon



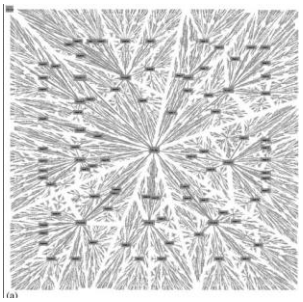
Viewing and Navigation

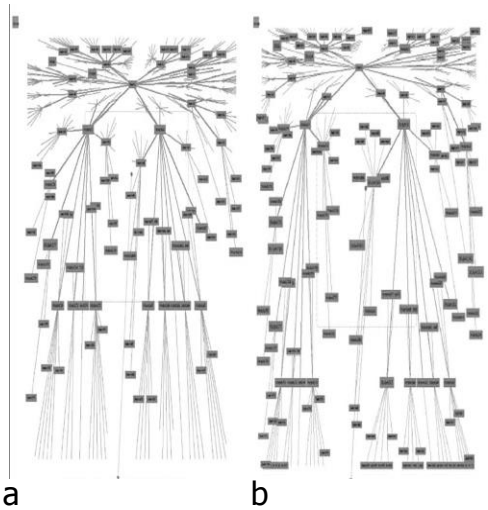
- Modified Semantic Zooming
  - Reduce density of tree
  - Selected Node to Root
  - History Path



Viewing and Navigation

- Focus + Context
  - Browsing (a)
  - Distortion (b)





a b

Transitioning a little to next time

CHEOPS

- CHEOPS: A Compact Explorer For Complex Hierarchies
- CRIM's Hierarchical Engine for OPen Search

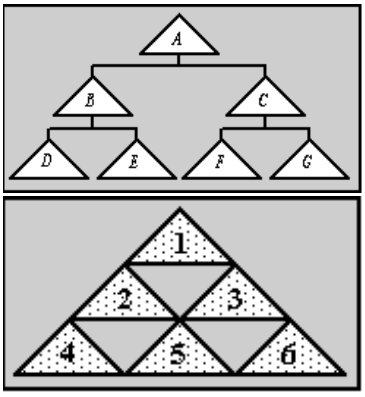
Beaudoin, Parent, Vroomen
Visualization '96

What CHEOPS Is

- Compressed visualization of hierarchical data, using triangle tessellation
- Most or all of the hierarchy can be displayed at once
- Since no Degree-of-Interest (DOI) function required, no major recalculation required when focus changes

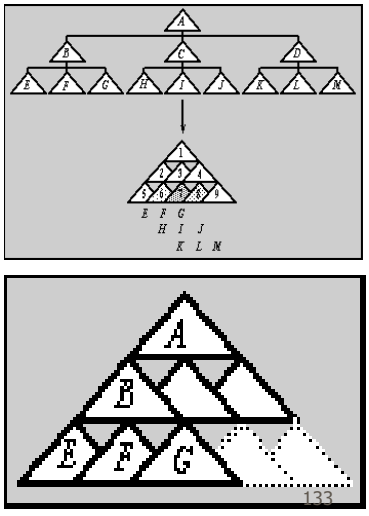
Triangle Tessellation

- Overlap/tile the triangles
- The visual object 5 is "overloaded" with the logical nodes E and F
- Insert overlapping triangles between logical nodes



What Tessellation Does (2)

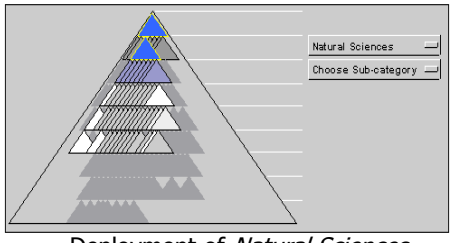
- To get a branch, select a node.
- The branch for the selected node will be "deployed"
- All parent nodes implicitly selected, as well.



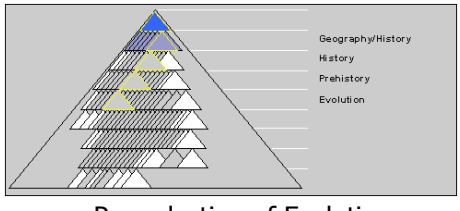
Getting A Branch With Reused Objects

- Selection
  - By selecting a node, the user sets a "reference state" in the hierarchy
- Pre-selection
  - As the cursor enters a triangle, the branch is highlighted, but not selected
  - Mouse-click to cycle through branches

Demo



Deployment of *Natural Sciences*



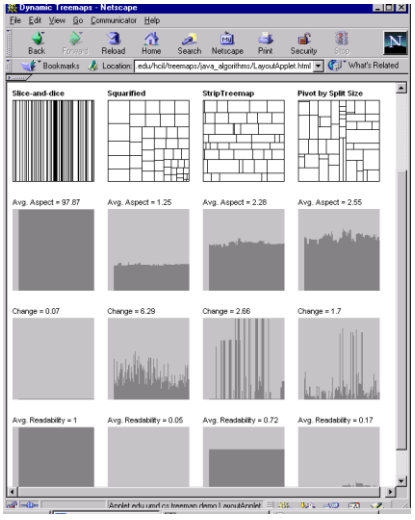
Pre-selection of Evolution

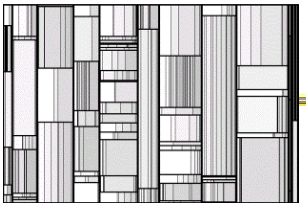
www.cs.umd.edu/hcil/treemap-history/java_algorithms/LayoutApplet.html

Compare results

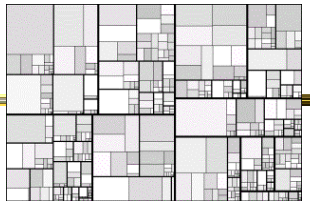
Compare
- slice and dice
- squarified
- strip
- pivot

techniques by
- aspect ratio
  - width to height
- structural change
  - metric designed to measure movements of items
- readability
  - metric based on changes in direction of eye gaze as items scanned

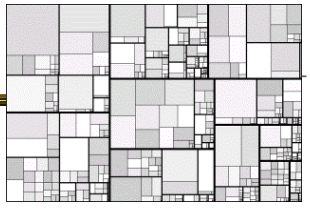




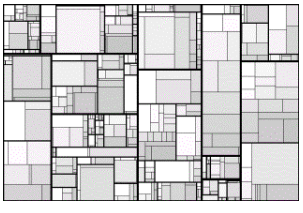
Slice-and-dice



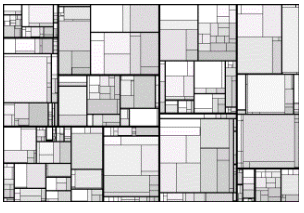
Cluster



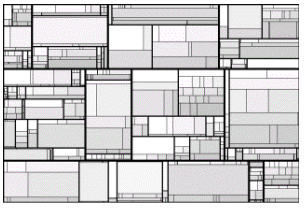
Squarified



Pivot-by-middle



Pivot-by-size



Strip

Another Problem

- What if nodes with zero value (mapped to area) are very important?
  - Example: Stock or mutual fund portfolios: Funds you don't currently hold have zero value in your portfolio, but you want to see them to potentially buy them

FundExplorer

- Show mutual fund portfolios, including funds not currently held
  - Area maps to your relative investment in fund
- Want to help the user with portfolio diversification as well
  - If I add fund X, how does that overlap with my current fund holdings?

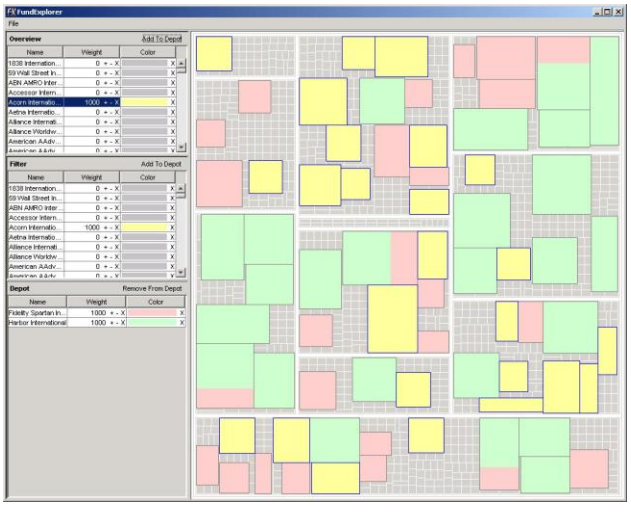
Solution

- Context Treemap – Treemap with small distortion
  - Give zero-valued items (all together) some constant proportion of screen area
  - Provide dynamic query capabilities to enhance exploration leading to portfolio diversification

FundExplorer

Video
InfoVis '03

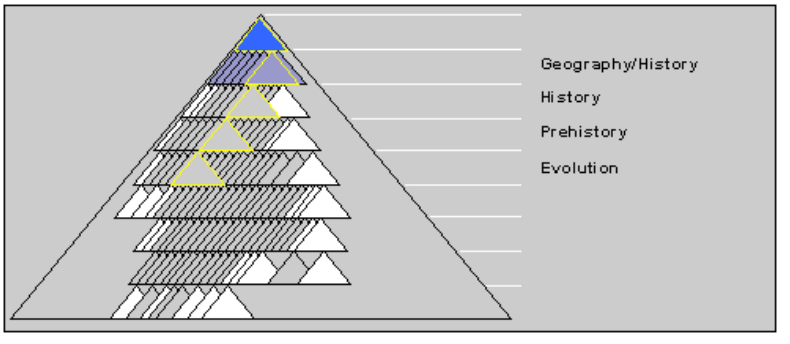
Demo



Hybrid Approaches

- Mix node-link and space-filling

CHEOPS



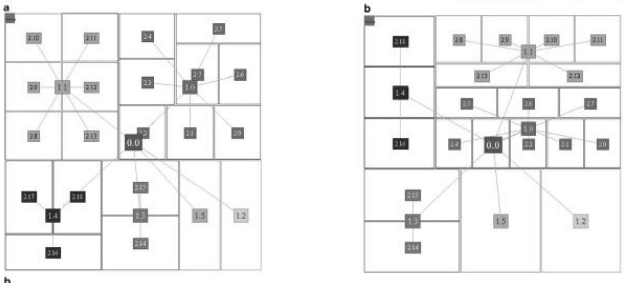
(Saw last time)

Beaudoin, Parent, Vroomen, Vis '96

EnCon

Nguyen & Huang
Information Visualization '05

- Explicit combination of node-link and treemap-like techniques
- Partition space into hierarchical regions, then draw node link into that



EnCon Sample Views