

## Lecture 13: Graphs and Trees

Information Visualization  
CPS5 533C, Fall 2006

Tamara Munzner

UBC Computer Science

24 October 2006

## Readings Covered

Graph Visualisation in Information Visualisation: a Survey. Ivan Hermann, Guy Melancon, M. Scott Marshall. IEEE Transactions on Visualization and Computer Graphics, 6(1), pp. 24-44, 2000. <http://citeseer.nj.nec.com/hermann00graph.html>

Animated Exploration of Graphs with Radial Layout. Ka-Ping Yee, Danyel Fisher, Rachna Dhamija, and Marti Hearst. Proc. InfoVis 2001. <http://ballando.sims.berkeley.edu/papers/infovis01.htm>

SpaceTree: Supporting Exploration in Large Node Link Tree, Design Evolution and Empirical Evaluation. Catherine Plaisant, Jesse Grosjean, and Ben B. Bederson. Proc. InfoVis 2002. <http://ftp.cs.umd.edu/pub/hci/Reports-Abstracts-Bibliography/2002-05/ste2002-05.pdf>

Cushion Treemaps. Jack J. van Wijk and Huub van de Wetering. Proc. InfoVis 1999, pp 73-78. <http://www.win.tue.nl/~vanwijk/cdm.pdf>

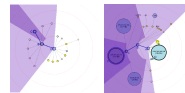
Multiscale Visualization of Small World Networks. David Auber, Yves Chircioita, Fabien Jourdan, Guy Melancon. Proc. InfoVis 2003. <http://dept.info.labri.fr/~auber/documents/publi/suber/vis03Seattle.pdf>

## Hermann survey

- true survey, won't try to summarize here
- nice abstraction work by authors
  - Strahler skeletonization
  - ghosting, hiding, grouping



## Animated Radial Layouts



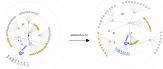
[Animated Exploration of Graphs with Radial Layout. Ka-Ping Yee, Danyel Fisher, Rachna Dhamija, and Marti Hearst. Proc. InfoVis 2001. <http://ballando.sims.berkeley.edu/papers/infovis01.htm>]

## Dynamic Graph Layout

- static radial layouts: known algorithm
- dynamic: little previous work
  - DynaDAG [North, Graph Drawing 95]
  - DA-TU [Huang, Graph Drawing 98]
- minimize visual changes
- stay true to current dataset structure
- video

## Animation

- polar interpolation
- maintain neighbor order



[Animated Exploration of Graphs with Radial Layout. Ka-Ping Yee, Danyel Fisher, Rachna Dhamija, and Marti Hearst. Proc. InfoVis 2001.]

## More Dynamic Graphs

video

- Dynamic Drawing of Clustered Graphs. Yaniv Frishman, Ayellet Tal. InfoVis 2004 Video Proceedings

## SpaceTree

- focus+context tree
  - animated transitions
- semantic zooming
- demo



## Treemaps

- containment not connection
- difficulties reading



## Cushion Treemaps

- show structure with shading
  - scale parameter controls global vs. local



## Treemap Applications

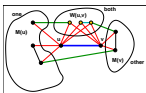
- cushion treemaps
  - SequoiaView, Windows app
  - hard drive usage
  - <http://www.win.tue.nl/~sequoia/view/>
- popular lately
  - <http://www.cs.umd.edu/hcil/treemap-history/>

## Small-World Networks

- high clustering, small path length
  - vs. random uniform distribution
- examples
  - social networks
  - movie actors
  - Web
  - software reverse engineering
- multiscale small-world networks
  - exploit these properties for better layout

## Strength Metric

- strength: contribution to neighborhood cohesion
- calculate for each edge based on
  - edge's POV partition of graph: one, other, both



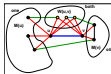
## Strength via Cycles

- 3-cycles through (u,v) + 4-cycles through (u,v)



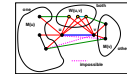
## Cycles: Cohesion Measure

- 3-cycles through u/v
- blue + 2 red edges == yellow nodes in both



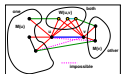
## Cycles: Cohesion Measure

- 3-cycles through u/v
  - blue + 2 red edges == yellow nodes in both
- all other 3-cycles don't contain blue u/v edge
  - magenta edges impossible
  - black, red/green, red/black, etc



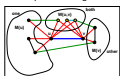
## Cycles: Cohesion Measure

- 3-cycles through  $u/v$ 
  - blue + 2 red edges == yellow nodes in both
- existing = yellow nodes
- all possible = all nodes



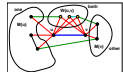
## Cycles: Cohesion Measure

- 4-cycles through  $u/v$ 
  - blue + 2 red + 1 green
  - blue + 2 red + 1 cyan
- $s(A, B) = \frac{\text{existing edges between sets}}{\text{all possible edges between sets}}$



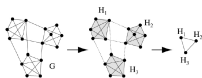
## Strength

- 4-cycles [green edges]
  - one-both, other-both, one-other
  - $s(M(u), W(u, v)) + s(M(v), W(u, v)) + s(M(u), M(v))$
- 4-cycles [cyan edges]
  - both-both
  - $s(W(u, v))$
- 3-cycles [yellow nodes in both]
  - $|W(u, v)| / (|M(u)| + |M(v)|) + |W(u, v)|$



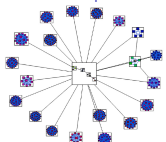
## Hierarchical Decomposition

- remove low-strength edges
- maximal disconnected subgraphs
- quotient graph: subgraph = higher-level node



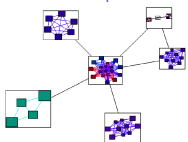
[Multiscale Visualization of Small World Networks, Auber, Chircioiu, Jourdan, and Malmgren, Proc. InfoVis 2003]

## Nested Quotient Graphs



[Multiscale Visualization of Small World Networks, Auber, Chircioiu, Jourdan, and Malmgren, Proc. InfoVis 2003]

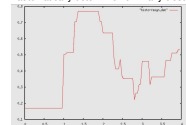
## Nested Quotient Graphs



[Multiscale Visualization of Small World Networks, Auber, Chircioiu, Jourdan, and Malmgren, Proc. InfoVis 2003]

## Clustering Quality Metric

- automatically determine how many clusters

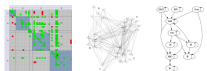


[Multiscale Visualization of Small World Networks, Auber, Chircioiu, Jourdan, and Malmgren, Proc. InfoVis 2003]

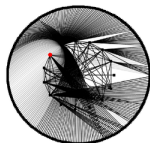
## Critique

- pros
  - exploit structure of data
  - hierarchical structure shown visually
  - automatically determine number of clusters
  - nifty math
- cons
  - information density could be better
  - what if mental model doesn't match clustering metric?

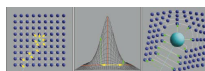
## Previous: Multilevel Call Matrices



## Previous: EdgeLens



## Previous: Visual Access Distortion



## Previous: H3



## Previous: TJ

