Lecture 13: Graphs and Trees

Information Visualization
CPSC 533C, Fall 2006

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UBC Computer Science

24 October 2006

Readings Covered

Graph Visualisation in Information Visualisation: a Survey. Ivan Herman, Guy Melancon, M. Scott Marshall. IEEE Transactions on Visualization and Computer Graphics, 6(1), pp. 24-44, 2000. http://citeseer.nj.nec.com/herman00graph.html

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

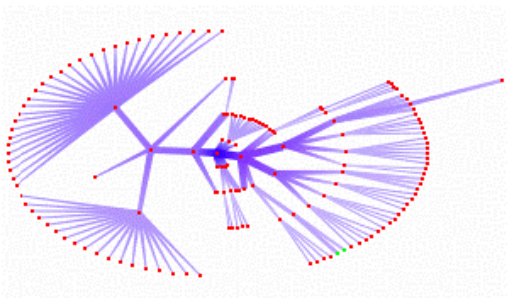
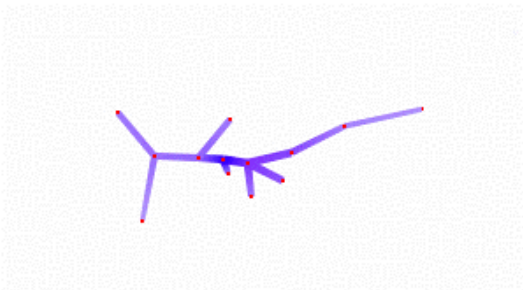
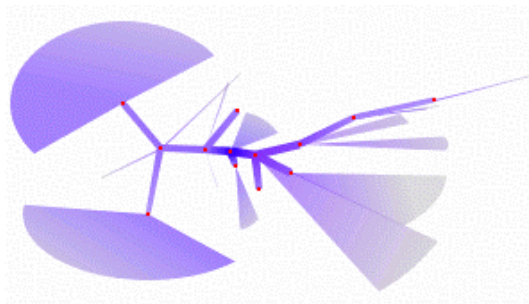
SpaceTree: Supporting Exploration in Large Node Link Tree, Design Evolution and Empirical Evaluation. Catherine Plaisant, Jesse Grosjean, and Ben B. Bederson. Proc. InfoVis 2002. ftp://ftp.cs.umd.edu/pub/hcil/Reports-Abstracts-Bibliography/2002-05html/2002-05.pdf

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

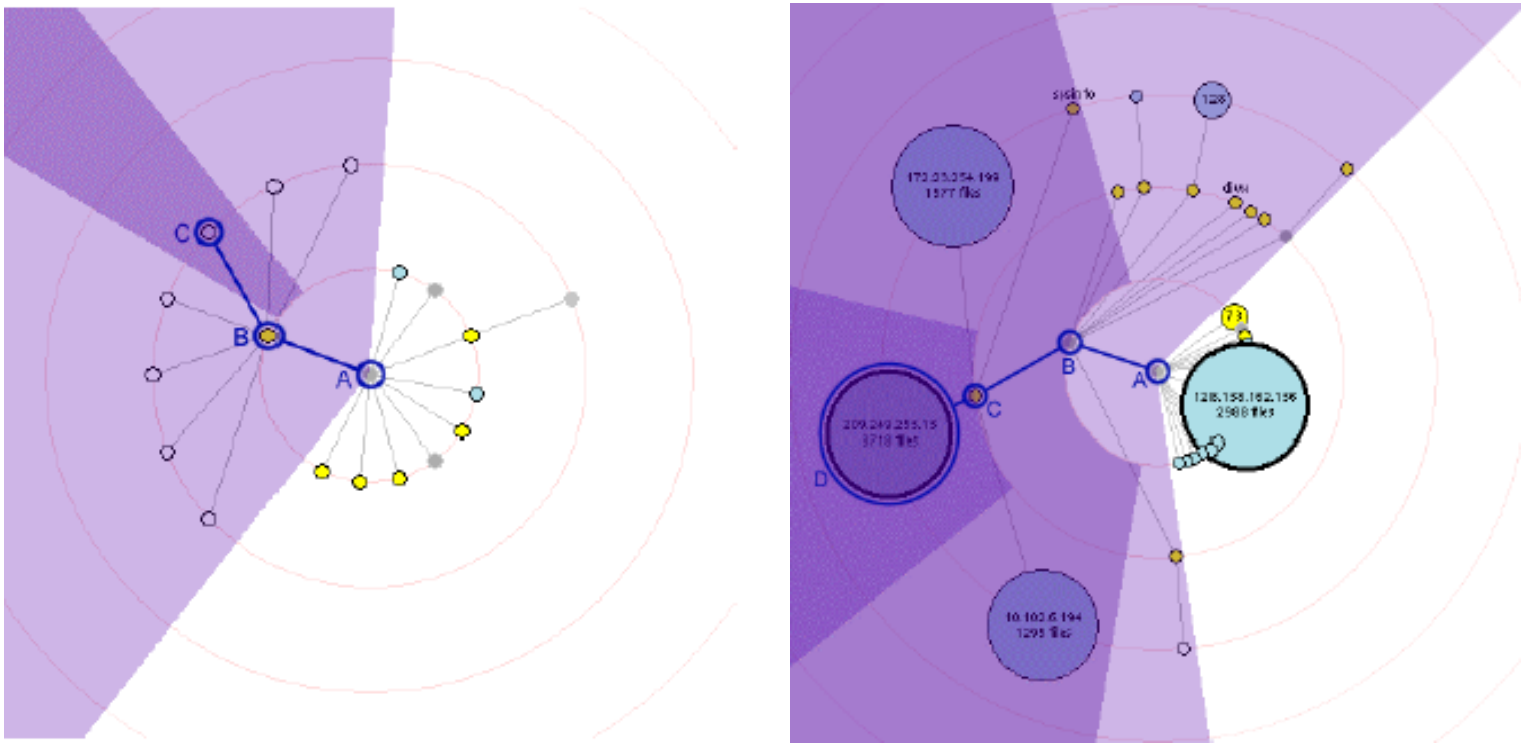
Multiscale Visualization of Small World Networks. David Auber, Yves Chiricota, Fabien Jourdan, Guy Melancon, Proc. InfoVis 2003. http://dept-info.labri.fr/~auber/documents/publi/auberIV03Seattle.pdf

Hermann survey

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

Animated Radial Layouts



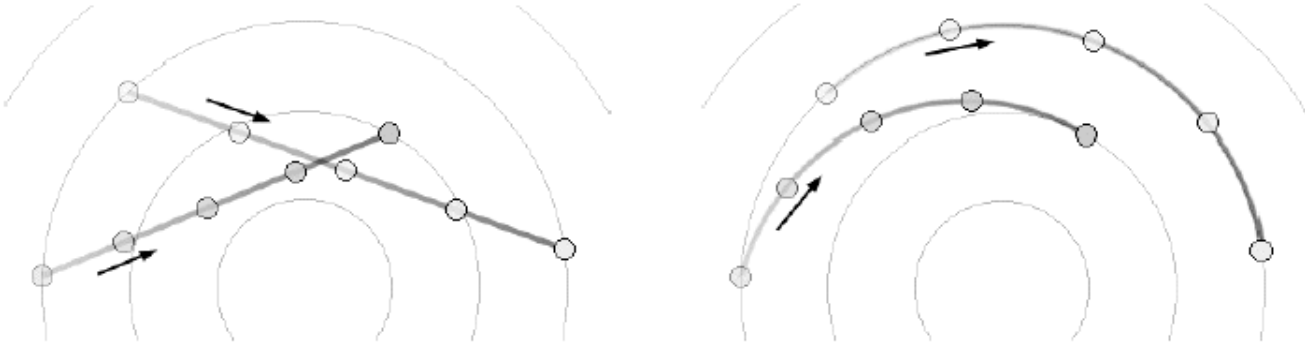
[Animated Exploration of Graphs with Radial Layout. Ka-Ping Yee, Danyel Fisher, Rachna Dhamija, and Marti Hearst, Proc InfoVis 2001. http://bailando.sims.berkeley.edu/papers/infovis01.htm]

Dynamic Graph Layout

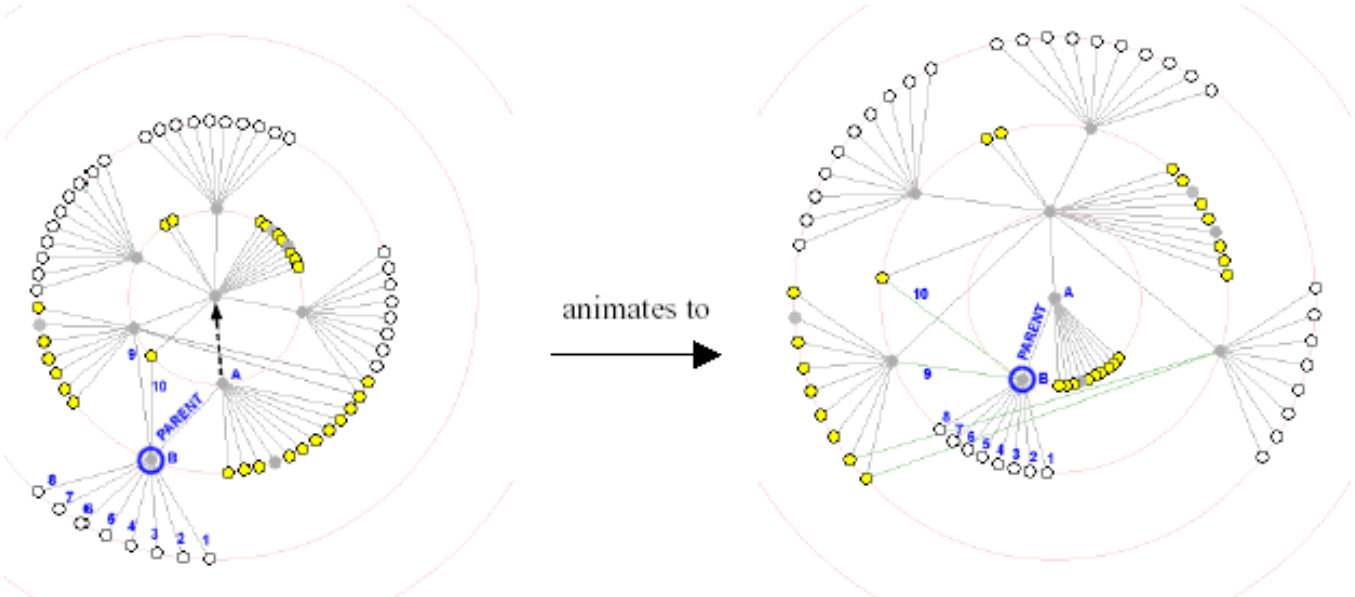
- static radial layouts: known algorithm
- dynamic: little previous work
  - DynaDAG [North, Graph Drawing 95]
  - DA-TU [Huang, Graph Drawing 98]
- minimize visual changes
- stay true to current dataset structure
- video

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.]

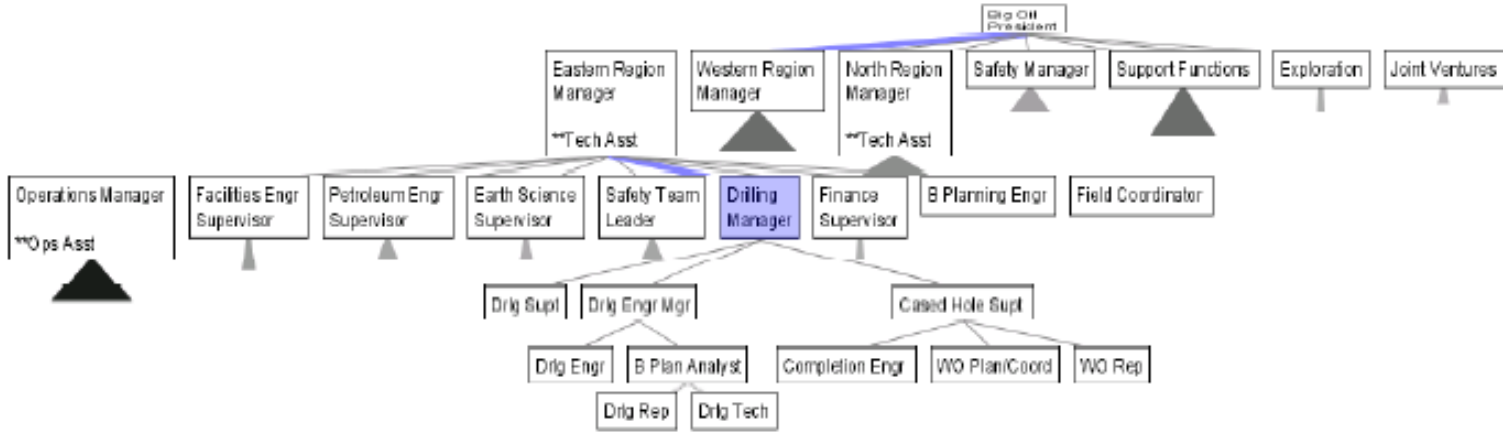
More Dynamic Graphs

video

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

SpaceTree

- focus+context tree
  - animated transitions

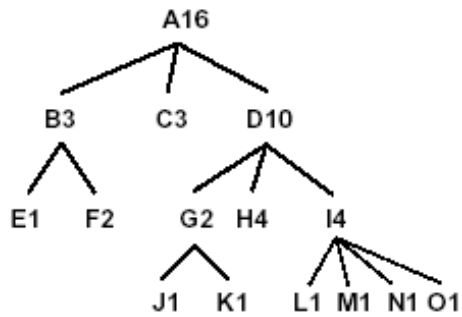


- semantic zooming

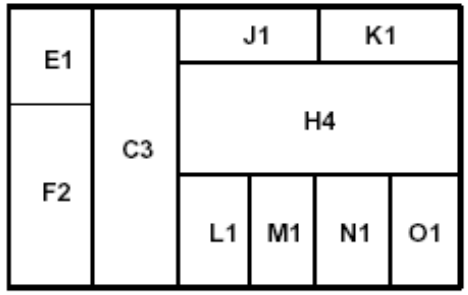
- demo

Treemaps

- containment not connection

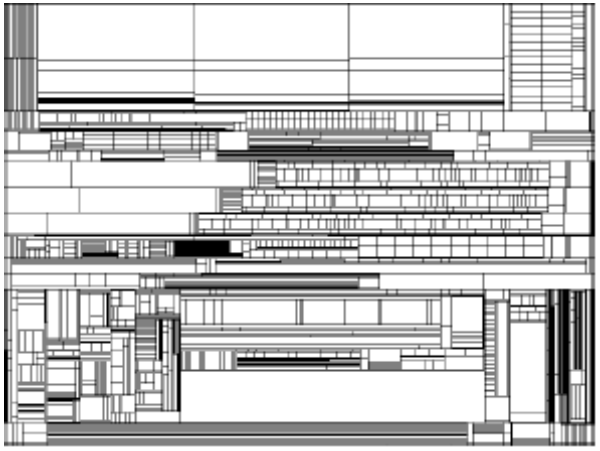


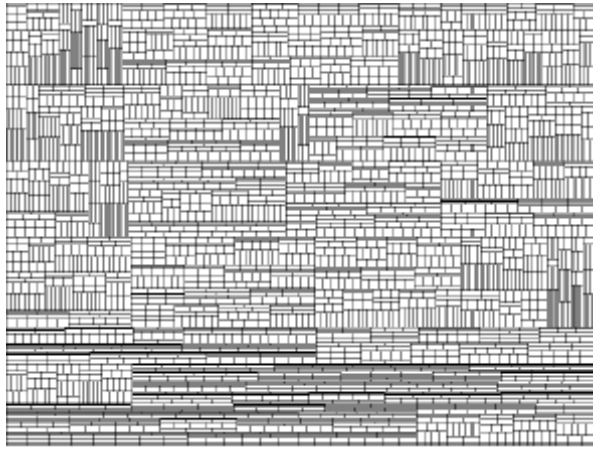
Node and link diagram



Treemap

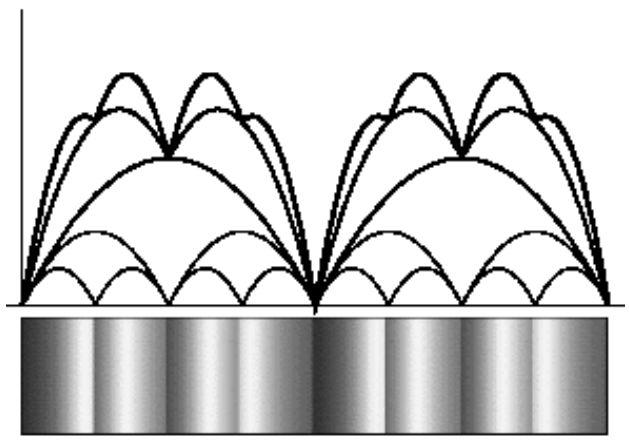
- difficulties reading

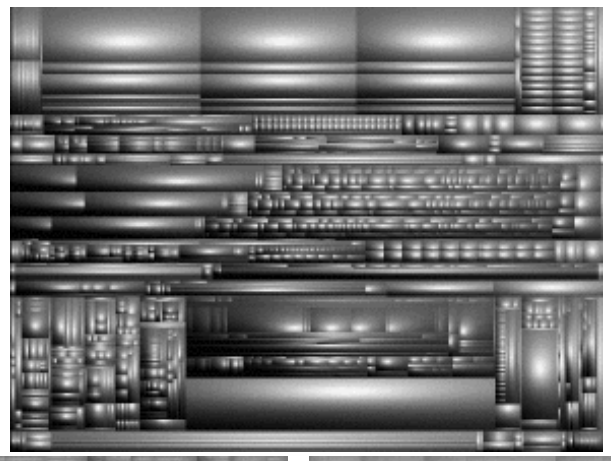


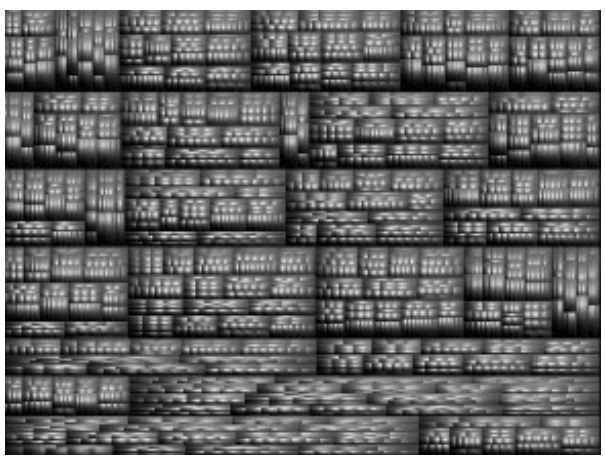


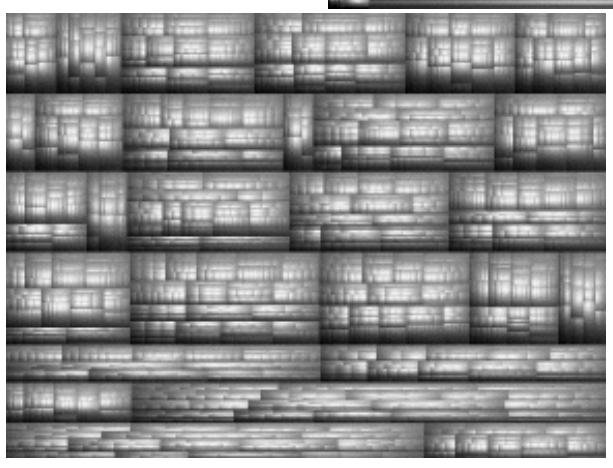
Cushion Treemaps

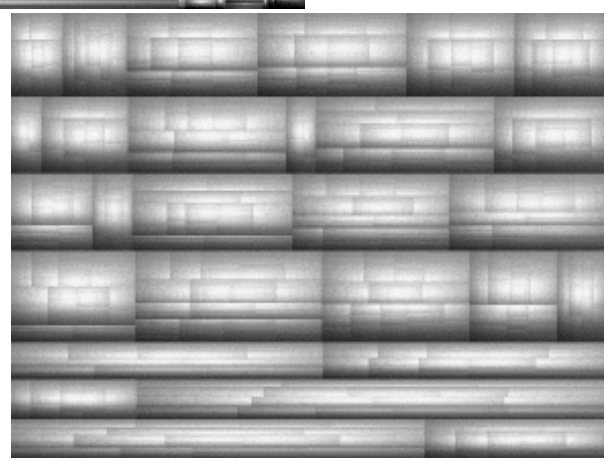
- show structure with shading
  - scale parameter controls global vs. local











Treemap Applications

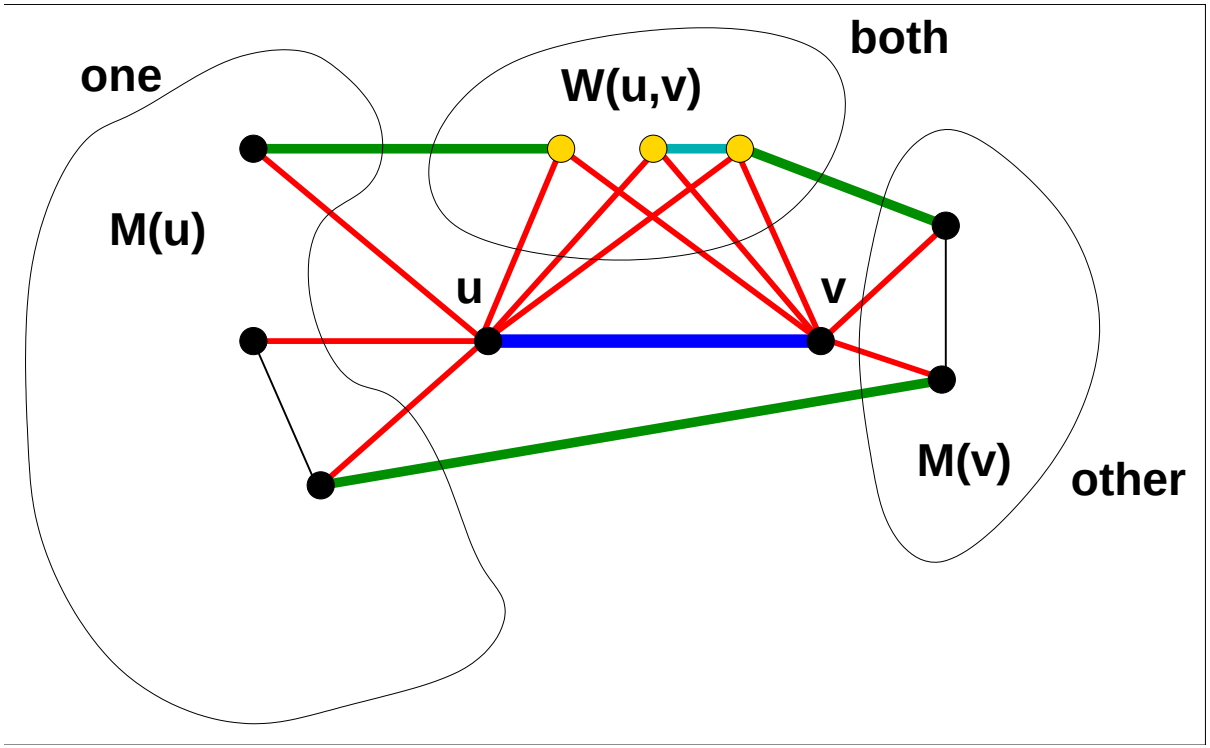
- cushion treemaps
  - SequoiaView, Windows app
  - hard drive usage
  - http://www.win.tue.nl/sequoiaview/
- popular lately
  - http://www.cs.umd.edu/hcil/treemap-history/

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

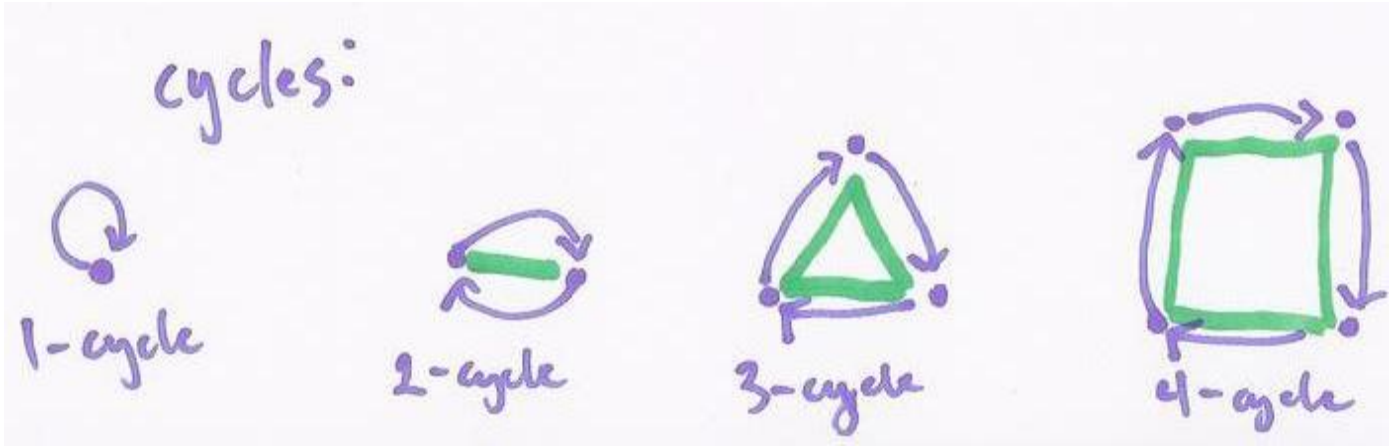
Strength Metric

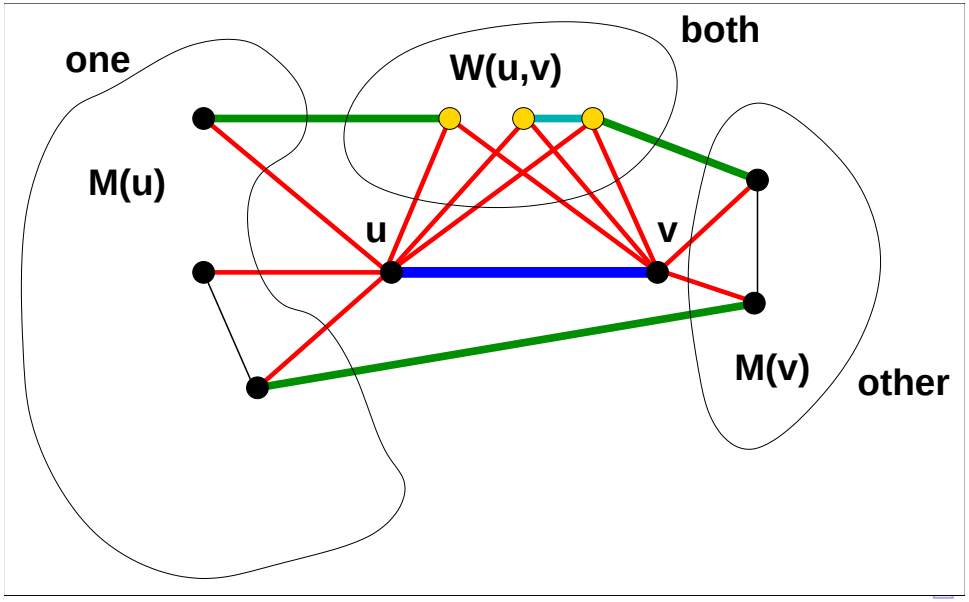
- strength: contribution to neighborhood cohesion
- calculate for each edge based on
  - edge's POV partition of graph: one, other, both



Strength via Cycles

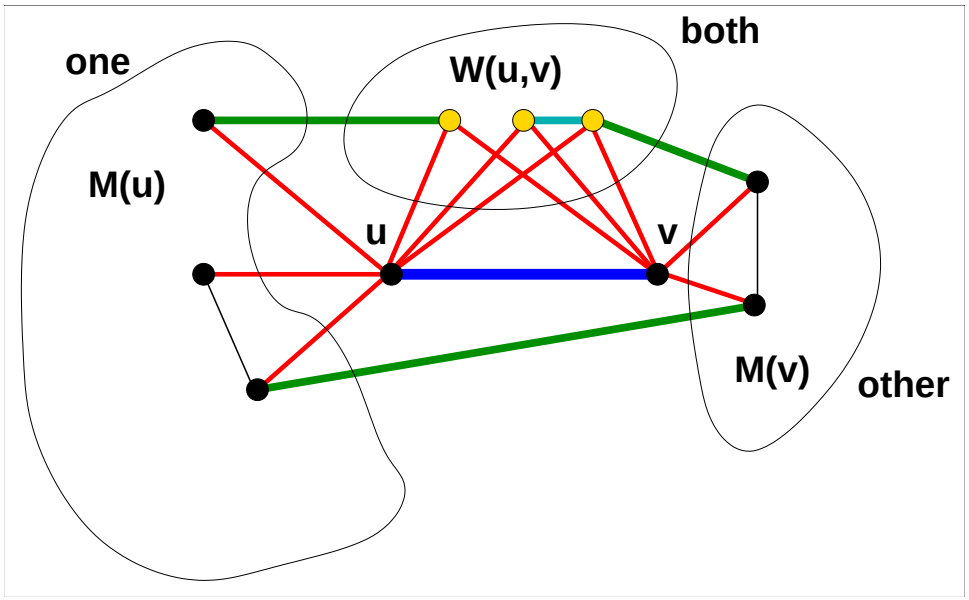
- 3-cycles through (u,v) + 4-cycles through (u,v)





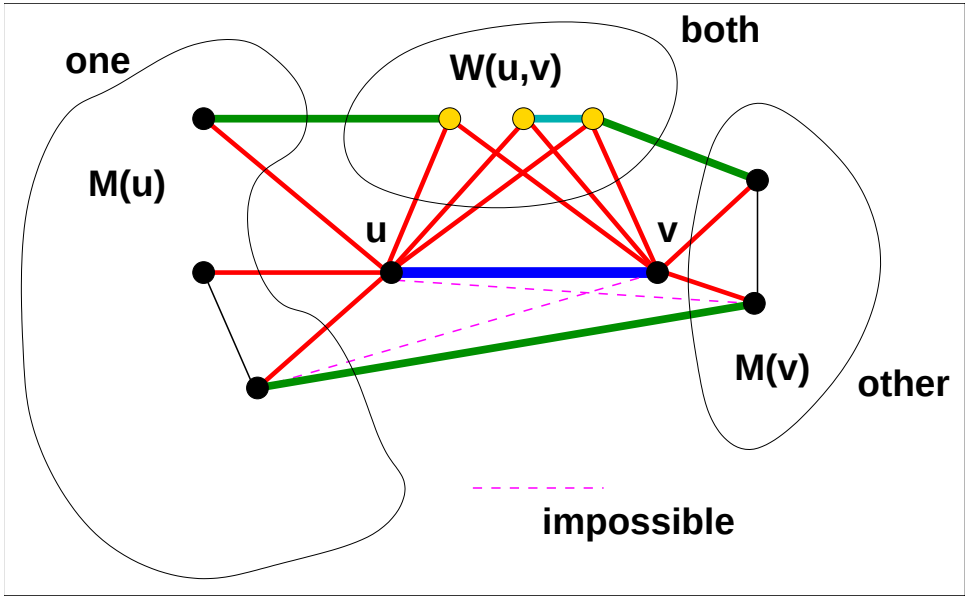
Cycles: Cohesion Measure

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



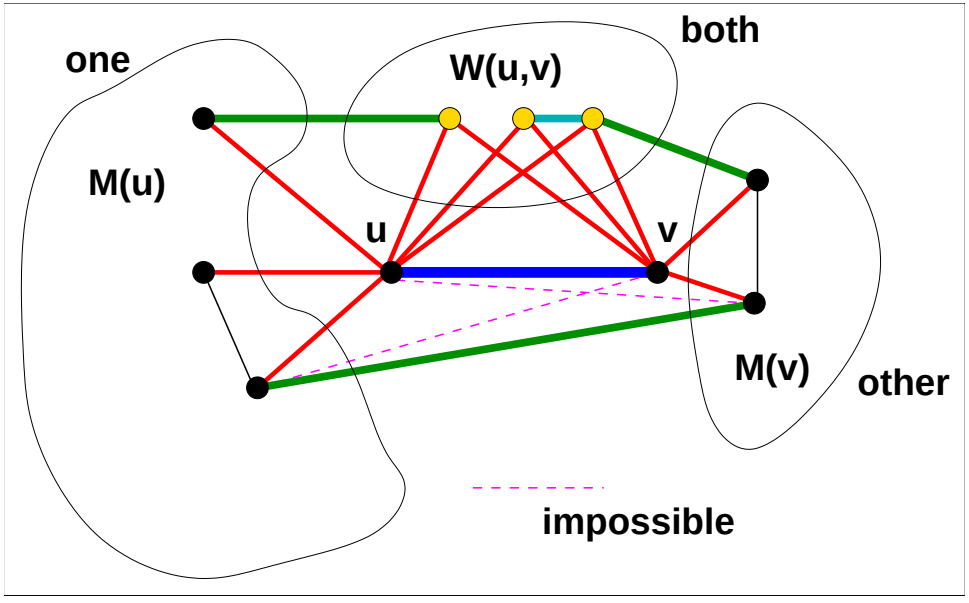
Cycles: Cohesion Measure

- 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



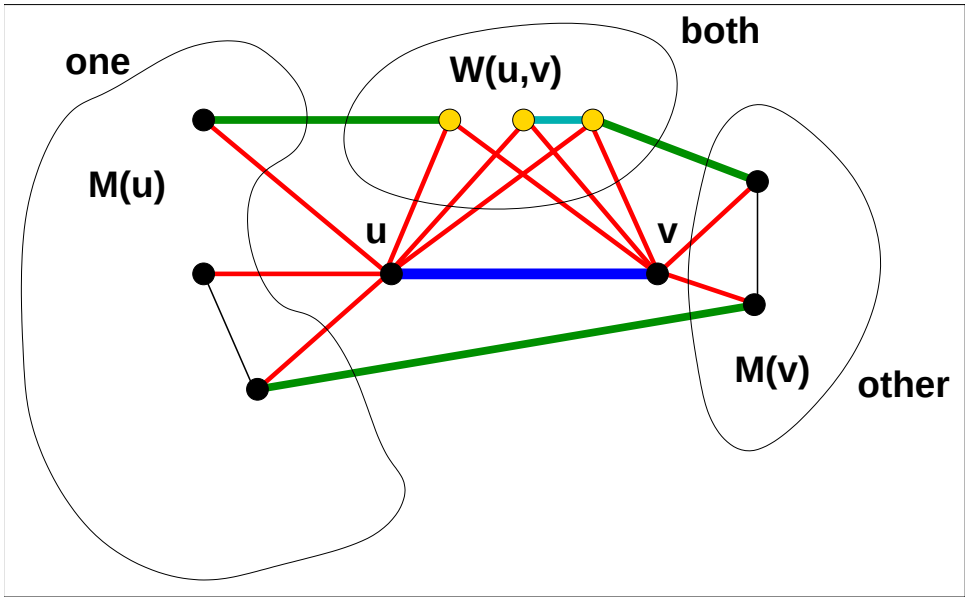
Cycles: Cohesion Measure

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



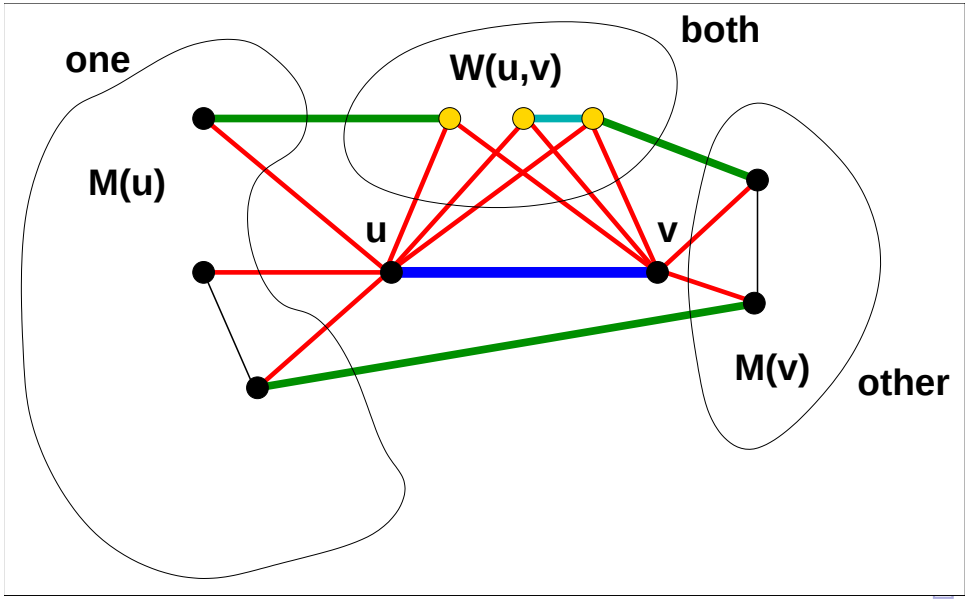
Cycles: Cohesion Measure

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



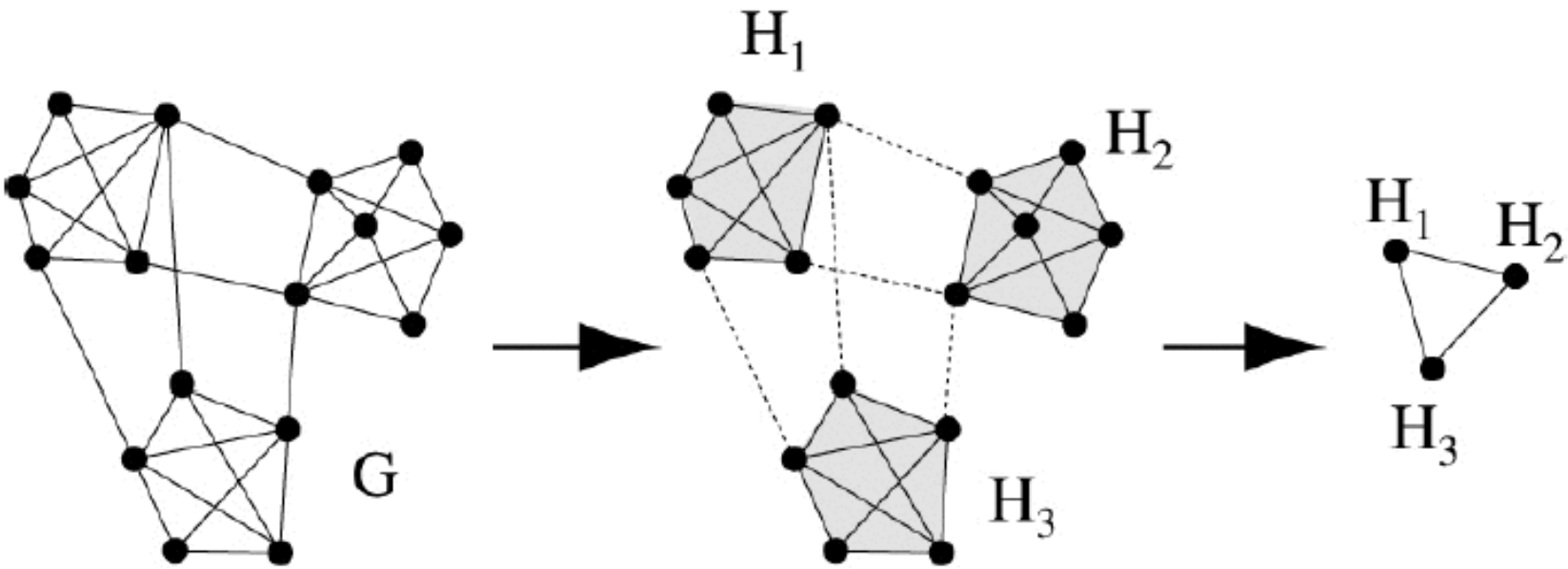
Strength

- 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]
  - $|W(u,v)|/(|M(u)|+|M(v)|+|W(u,v)|)$



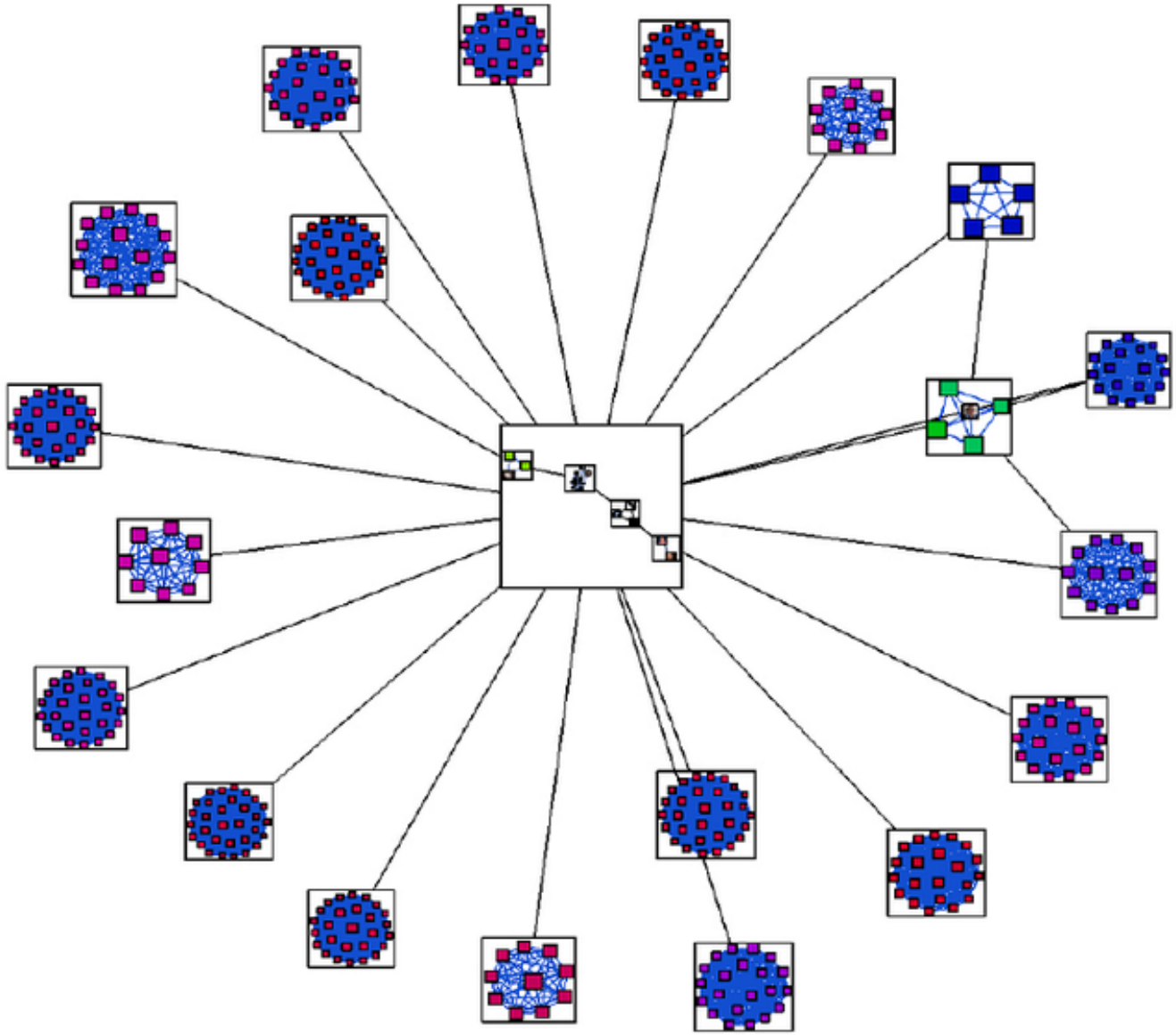
Hierarchical Decomposition

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



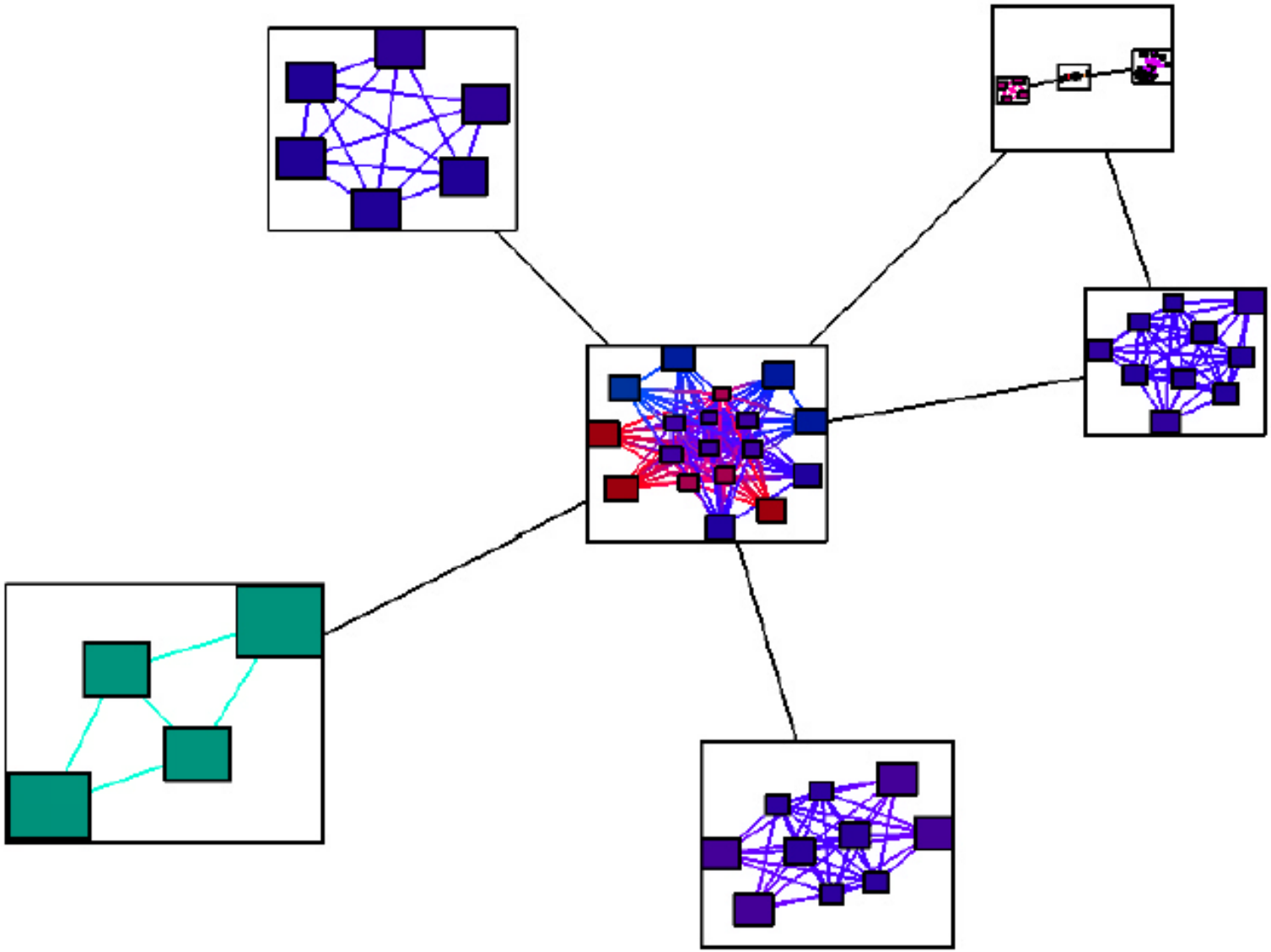
[Multiscale Visualization of Small World Networks. Auber, Chiricota, Jourdan, and Melancon. Proc. InfoVis 2003]

Nested Quotient Graphs



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

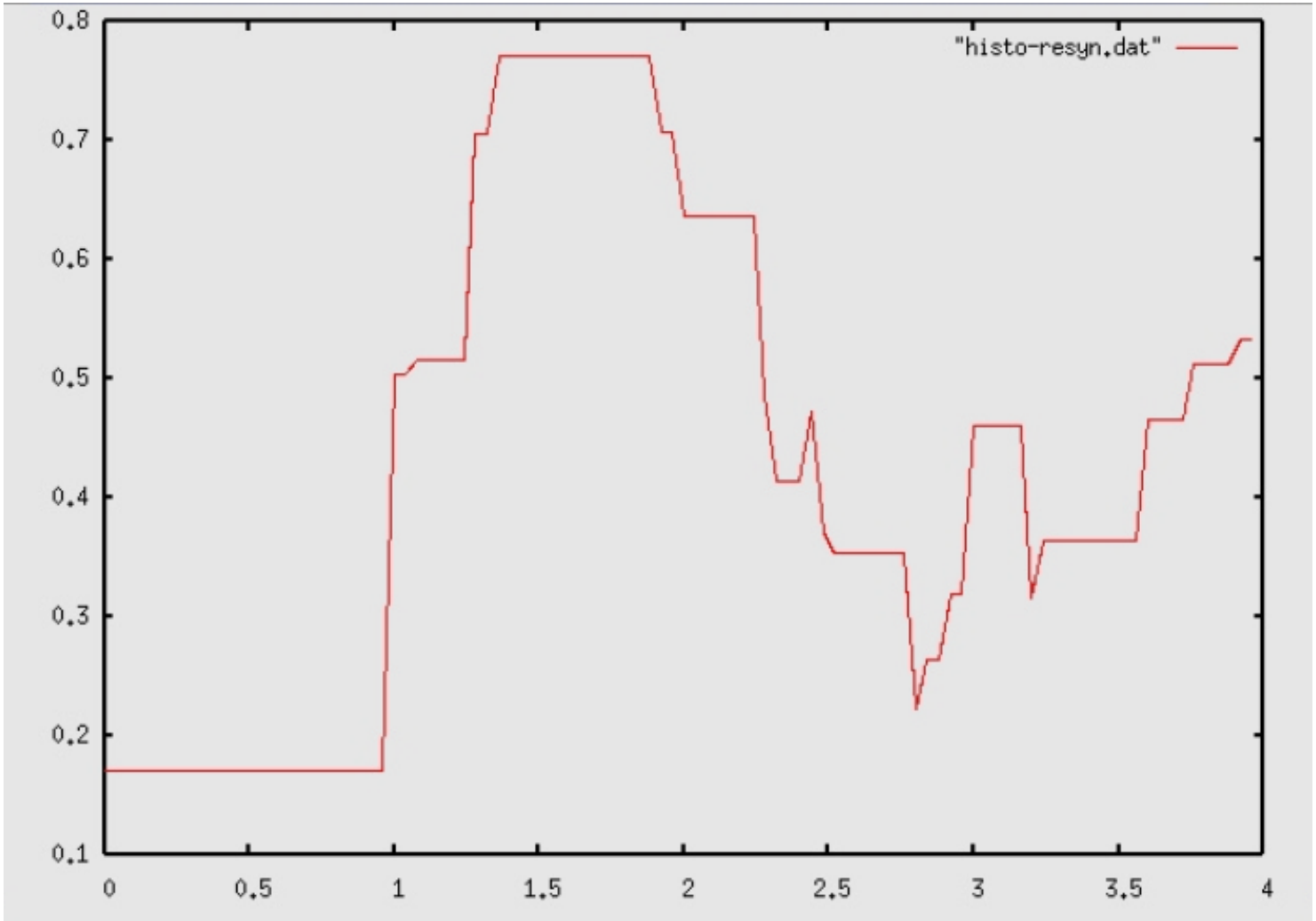
Nested Quotient Graphs



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

Clustering Quality Metric

- automatically determine how many clusters

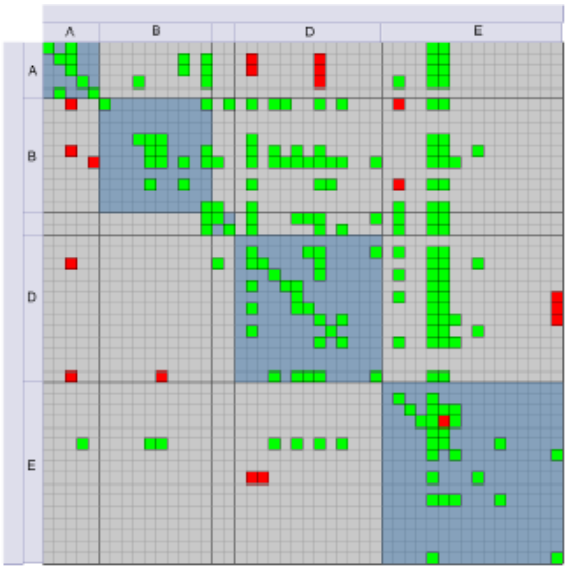


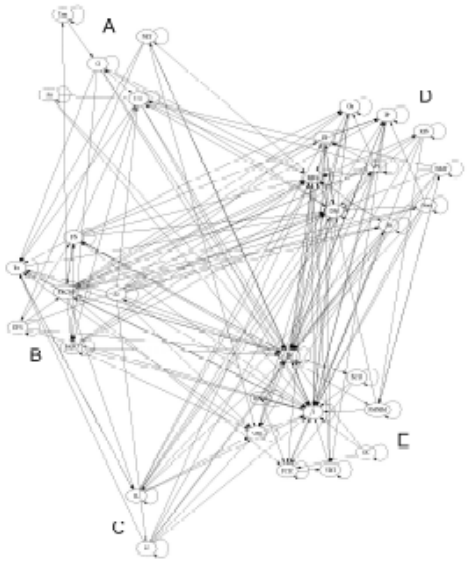
[Multiscale Visualization of Small World Networks. Auber, Chiricota, Jourdan, and Melancon. Proc. InfoVis 2003]

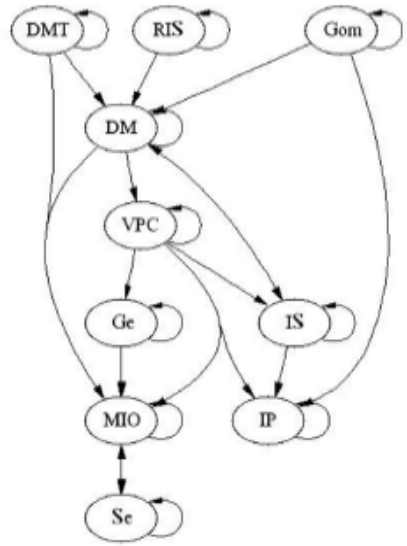
Critique

- 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?

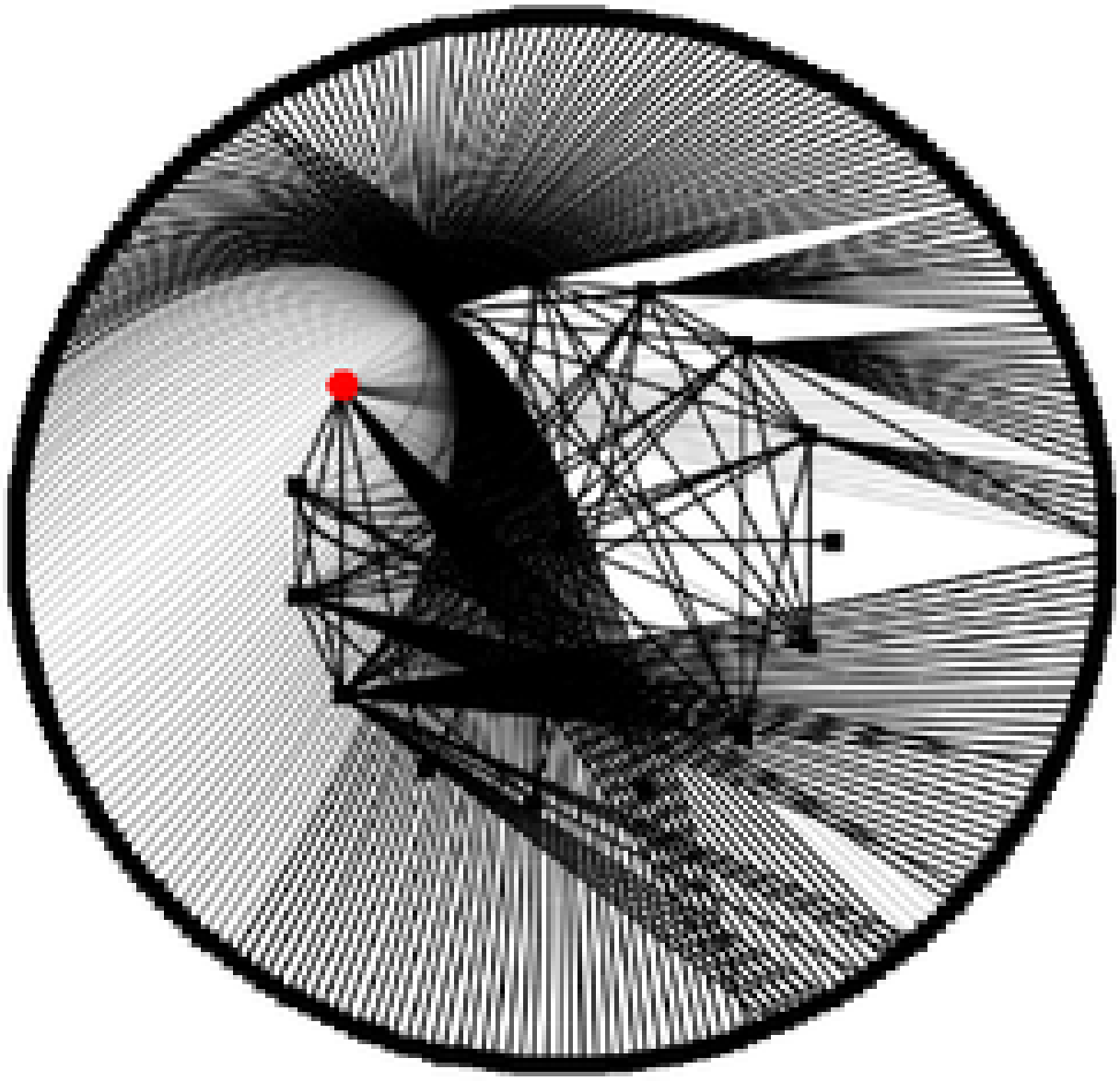
Previous: Multilevel Call Matrices



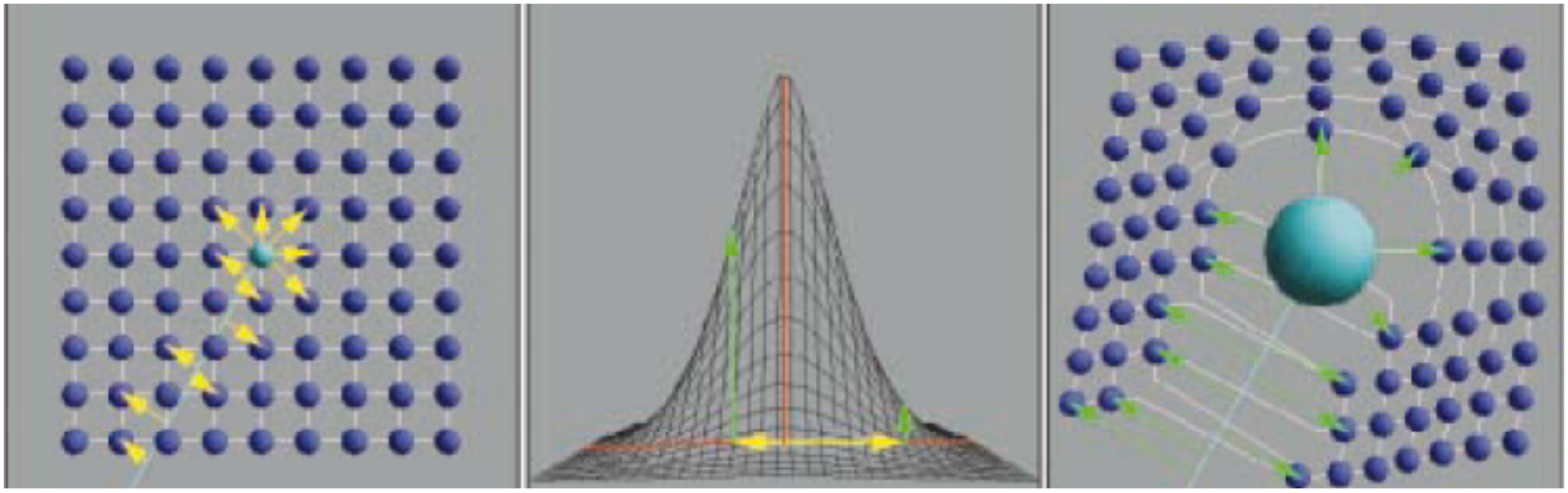




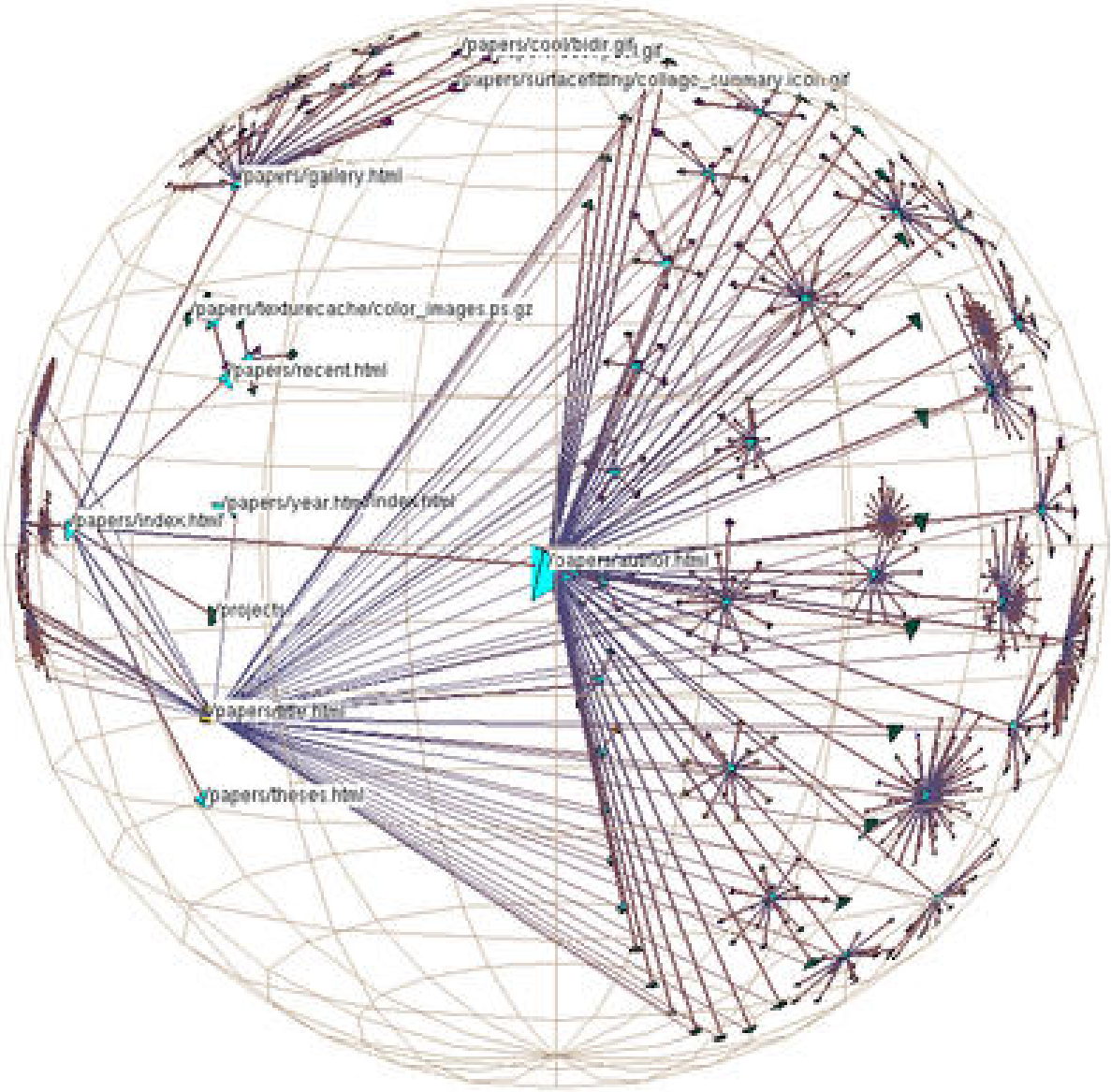
Previous: EdgeLens



Previous: Visual Access Distortion



Previous: H3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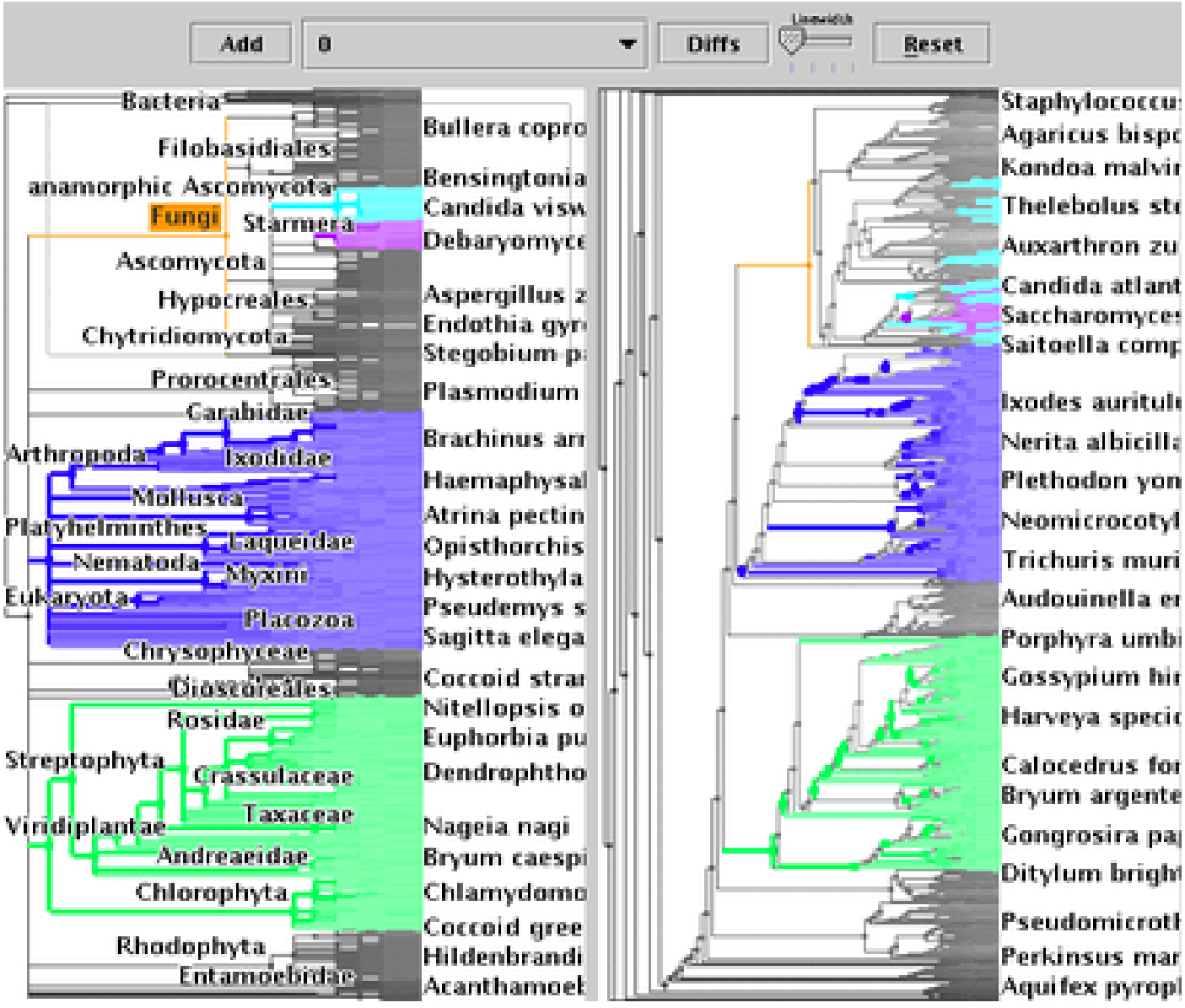
Previous: TJ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Bacteria
Filobasidiales
anamorphic Ascomycota
Fungi
Starmera
Ascomycota
Hypocreales
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Prorocentrales
Carabidae
Arthropoda
Ixodidae
Mollusca
Platyhelminthes
Laqueidae
Nematoda
Myxini
Eukaryota
Placozoa
Chrysophyceae
Dioscoreales
Rosidae
Streptophyta
Crassulaceae
Taxaceae
Viridiplantae
Andreaeidae
Chlorophyta
Rhodophyta
Entamoebidae
Bullera copro
Bensingtonia
Candida visw
Debaryomyce
Aspergillus z
Endothia gyr
Stegobium p
Plasmodium
Brachinus an
Haemaphysal
Atrina pectin
Opisthorchis
Hysterothyla
Pseudemys s
Sagitta elega
Coccoid strai
Nitellopsis o
Euphorbia pu
Dendrophtho
Nageia nagi
Bryum caespi
Chlamydomo
Coccoid gree
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Acanthamoeb
Staphylococcu
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Auxarthron zu
Candida atlant
Saccharomyce
Saitoella comp
Ixodes auritul
Nerita albicill
Plethodon yon
Neomicrocotyl
Trichuris muri
Audouinella e
Porphyra umbi
Gossypium hi
Harveya speci
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Bryum argente
Congrosira pa
Ditylum bright
Pseudomicroth
Perkinsus mar
Aquifex pyropl