Network Visualization
by Semantic Substrates

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State-of-the-art network visualization
Node Placement Methods

• Node-link diagrams
  • Force-directed layout
  • Geographical map
  • Circular layout
  • Temporal layout
  • Clustering
  • *Layouts based on node attributes (later)*

• Matrix-based
• Tabular textual
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NetViz Nirvana

1) Every node is visible
2) For every node you can count its degree
3) For every link you can follow it from source to destination
4) Clusters and outliers are identifiable
NetViz Nirvana

How to attain NetViz Nirvana?
NetViz Nirvana

Semantic Substrates
Semantic Substrates

• Group nodes into regions
  According to an attribute
    Categorical, ordinal, or binned numerical
Semantic Substrates

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• In each region:
  Place nodes according to other attribute(s)
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• Give users control of link visibility
Force Directed Layout

36 • Supreme & 13 ○ Circuit Court decisions
268 citations on Regulatory Takings 1978-2002
Network Visualization by Semantic Substrates

NVSS 1.0

[Diagram of network visualization with nodes and connections labeled Supreme and Circuit for different years.]
Filtering links by source-target
Filtering links by time attribute (1)
Filtering links by time attribute (2)
Overlapped Links
Three Regions

- Links from District Courts
- Indicates longevity of cases (short to long)
  - District
  - Circuit
  - Supreme
Scalability

- 1280x1024
- 1,122 nodes
- 7,645 links
Using a third attribute in regions

- 13 circuits for both Circuit and District Courts
- Horizontally separated
- Reveals that links remain mostly within a circuit although there are some across (lateral citations)
Semantic Substrates

• Advantages
  • Location conveys meaning
  • Rapid visual identification of
    • Different types of nodes
    • Their relative number
    • Missing nodes
    • Connections between different groups of nodes
  • Scalable for nodes and links

• Limitations
  • Beyond 5 regions becomes challenging
  • Node placement interferes with link aesthetics
  • Control panel can get complex
Email To & CC list co-recipients

- UMD
- COM
- EDU
- ORG

- Female
- Male
- Jr
- Med
- Sr

- Low
- Med
- High
Foodwebs

- Mammals
- Reptiles
- Insects
- Fish
- Birds
Group nodes into regions
According to an attribute
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In each region:
Place nodes according to other attribute(s)

Give users control of link visibility

Lab  www.cs.umd.edu/hcil
Project  www.cs.umd.edu/hcil/nvss
Demo  www.cs.umd.edu/~aris/nvss
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Challenges of Network Visualization

• C1) Basic networks: nodes and links

• C2) Node labels
  • e.g. article title, book author, animal name

• C3) Link labels
  • e.g. Strength of connection, type of link

• C4) Directed networks

• C5) Node attributes
  • Categorical, Ordinal, Numerical

• C6) Link attributes
  • Categorical, Ordinal, Numerical