

Graph Drawing

Graph Visualization and Navigation in Information Visualization: A Survey

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„Search, Show Context, Expand on Demand“: Supporting Large Graph Exploration with Degree-of Interest

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Overview

- Key issues in Graph Visualization
- Clustering
- Extending DOI to graphs – *Search context*
- *Show and Expand-on-Demand context*
- Implementation example

Key issues in Graph Visualization

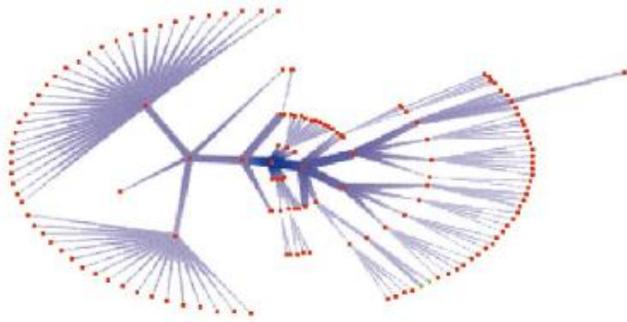
- Size
 - Performance, display limit
 - Viewability and usability
 - Cognitive perspective
- Planarity
 - When dealing with small and sparse graphs
 - Drawing graph without edge crossing
 - Various constraints such as *aesthetic rules*
- Predictability
 - „preserving the mental map of the user“
- Time complexity
 - Real time interaction
 - Updates in very short time intervals

Clustering

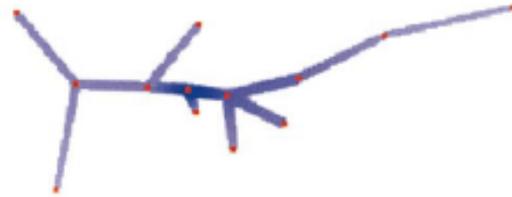
- Improves clarity and increases performance, rendering
- Structure-based vs. content-based
- Used for *filter* and *search*
- Layout
 - Representing clusters with glyphs – super nodes
 - Omitting edges
 - Hierarchical
 - Force-directed layout
- Node metrics: measure or quantify an abstract feature
 - Numeric computable function
 - E.g degree of node, Strahler metric, *Degree of Interest* from Furnas

Clustering

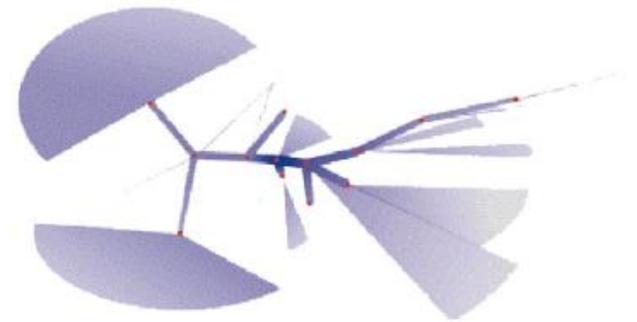
- Metrics are used to influence layout
- Kimelman's method for representing the unselected nodes
 - *Ghosting, Hiding, Grouping*



Ghosting



Hiding



Grouping

Extending DOI to Graphs

- Furnas' DOI function:

$$\text{DOI}(x|y) = \alpha \text{API}(x) + \beta D(x,y)$$

- A priori interest function *API*, distant function *D*, *x* location, *y* current focus
- Additional functions
 - *EI* (*e*,*x*,*y*) disinterest function → *Search* component
 - Defines path length between two arbitrary nodes in the graph
 - *UI* (*x*,*z*) user interest funct. → Many local maxima
 - Interest information known between the user chooses a focal node
 - *N*(*x*) intrinsic value of the neighbours
 - Interest of node depends on the max. of its own interest values and a fraction of its highest interest neighbours

Extending DOI to Graphs

- Final resulting function

$$\mathbf{DOI(x|y,z)=\alpha APIdiff(x) + \beta UI\ diff (x,z) + \gamma D(x,y)}$$

z-search parameter, y focus node

- Diffusing the interest values over the entire graph

Show and Expand-on-Demand Context

- *Show*

- How to efficiently compute a connected subgraph F with size at most S that contains y and has maximal total interest?
- \rightarrow Greedy optimization algorithm

- *Expand-on-Demand*

- use interest function to define which adjacent nodes are most important
- Highlight n most interesting directions ($n < 5$)

Implementation

The image shows a software interface for legal network analysis. The main window displays a network graph where nodes represent legal cases and edges represent relationships between them. Nodes are color-coded: dark green for Supreme Court cases and light green for Lower Federal Court cases. A search bar at the top right contains the text "flag burning" and a red box labeled 'a' is around it. The search results table on the right, labeled 'b', shows 500 matches. The table has columns for Parties, Size, and Date. The entry "TEXAS, Petitioner v. Gregory Lee" is highlighted in blue. Below the table, there are search filters for "A Priori Interest", "User Interest", "Falloff", "Directed", and "Network size" (set to 25), with a red box labeled 'd' around these controls. The network graph itself has several callouts: "Initial focal node (circled)" points to a central node; "Nodes that also matched search term" points to a cluster of nodes; "Number of invisible neighbors" points to a node with a blue number '40'; and "Interesting direction for expansion" points to a node with a blue number '13'. A legend at the bottom left identifies the node colors. A red box labeled 'c' is at the bottom right of the graph area.

Search a

Showing 500 of 500 matches (drag and drop on canvas to view)

Parties	Size	Date
SEA-LAND SERVICE, INC., Appella	1	Fri, Dec 23, '83
COLUMBIA STEAMSHIP COMPANY	2	Thu, Jan 16, '75
Robert LEONARD et al., Plaintiffs-	20>	Fri, Jul 1, '77
THE UNITED STATES, APPELLANTS	1	Thu, Dec 1, '59
Thomas Wayne JOYCE, Appellant	20>	Mon, Feb 28, '72
Clair D. KNIERIM, Plaintiff-Appelle	20>	Wed, Apr 22, '70
John FARLEY, Appellant, v. UNITE	1	Mon, Jan 6, '58
TEXAS, Petitioner v. Gregory Lee	20>	Wed, Jun 21, '89
GRACE LINE, INC., Petitioner, v. F	1	Fri, Feb 13, '59
UNITED STATES of America, Appe	1	Wed, Sep 14, '83
Diane MONROE, Petitioner-Appell	20>	Mon, Aug 20, '84
UNITED STATES ex rel. Stephen F	20>	Wed, Apr 26, '72
UNITED STATES of America, Plain	20>	Wed, Nov 15, '06
UNITED STATES of America, Plain	1	Tue, Jun 5, '90
UNITED STATES of America, Appe	20>	Mon, Feb 28, '83
Elena Jerezano MONCADA, as Per	1	Sun, Jan 20, '74
AUSTASIA INTERMODAL LINES, LT	1	Thu, May 4, '78
ATLANTIC RICHFIELD COMPANY, .	20>	Fri, Oct 11, '85
AMERICAN LIBRARY ASSOCIATIO	20>	Tue, Mar 15, '05
UNITED STATES of America v. Rot	20>	Wed, May 10, '72
ARO-CHEM CORPORATION, Plainti	2	Mon, Jun 8, '92
Hugo RODRIGUEZ, Plaintiff-Appel	1	Tue, Mar 15, '83
SEA-LAND SERVICE, INC., Petition	1	Tue, Jul 13, '82
EMERGENCY ONE, INCORPORATEC	1	Fri, Jun 9, '00
Jorier Haught YOST, Appellant, v.	1	Thu, Apr 3, '69

Search Directed Network size

Legend:
■ Supreme Court
■ Lower Federal Court

Basic UI layout.
van Ham and Perer

Conclusion

- Thorough description of key issues in first paper
 - Descriptions of techniques
 - Could be organized better
- Second paper presents solution to problems addressed in the first one
 - Implementation and evaluation also described
 - Future work well described
 - Algorithms could be more formal

References

- van Ham, F., Perer, A: „Search, Show Context, Expand od Demand“: Supporting Large Graph Exploration with Degree-of Interest, IEEL Transactions on visualization and Computer Graphics, Vol.15 No.6 (2009)
- Herman, I., Melancon, G., Marshall, M.S.: Graph Visualization and Navigation in Information Visualization: A Survey (2000)