

Graphs (more precisely, Networks)



CS 4460 - Information Visualization

Last update: September 2016

Graph Uses



- Many types of data can be modeled as a graph
 - US telephone system
 - World Wide Web
 - Distribution network for on-line retailer
 - Call graph of a large software system
 - Semantic map in an AI algorithm
 - Set of connected friends
- Graph/network visualization is one of the oldest and most studied areas of InfoVis

Typical Info in a Network?



- Node Info
 - ...
 - ...
- Link Info
 - ...
 - ...
- How visually encode multiple info?
 - Nodes
 - Links

TouchGraph



TouchGraph - Microsoft Internet Explorer

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TouchGraph LLC

TG Home News Contact, Jobs Amazon Browser Google Browser LiveJournal Browser

Dynamic Graph Layout

Click image to launch applet.

TG GoogleBrowser V1.01

Click image to go to project page

Planet-Wissen Navigator

Click image to launch applet.

TG WikiBrowser V1.02

Download + Run application

www.touchgraph.com

30-day free trial 😊

On-line demo

<http://www.touchgraph.com/seo>

Uses Force Directed Layout

Force-Directed Layout

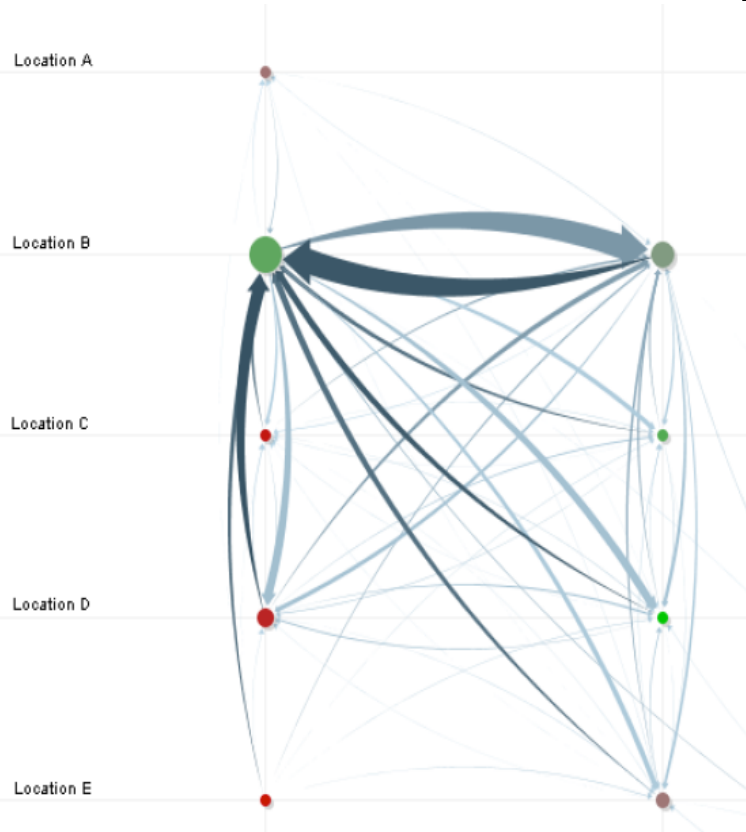


- Basic idea
 - Connected nodes attracted one to another (keep connected nodes close to one another)
 - All nodes repel one another (to prevent overlap)
 - Interactive tools often allow attractive and repulsive forces to be modified
- Many algorithms – iteratively modify node positions to achieve balance between pulls and pushes
 - Tutte, Eades, Fruchterman-Reingold, ...
- <https://bl.ocks.org/mbostock/4062045>

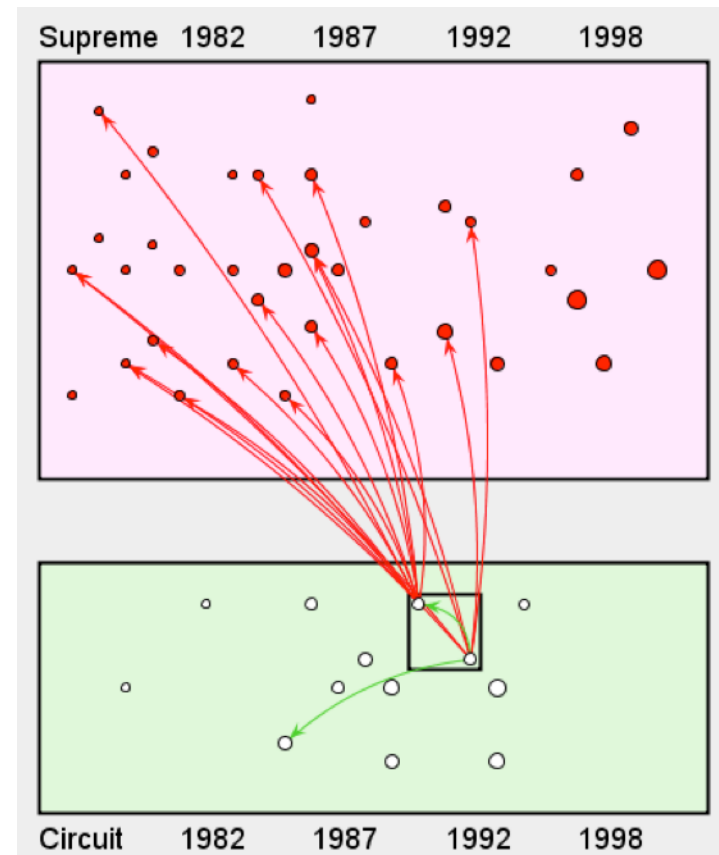
Two Important Graph Layouts



Pivot Graph (aggregate by common node attributes)



Semantic Substrates (segregate by common node attributes)



Think about differences as I discuss both layouts – prep for “talk with neighbor”

Pivot Graph



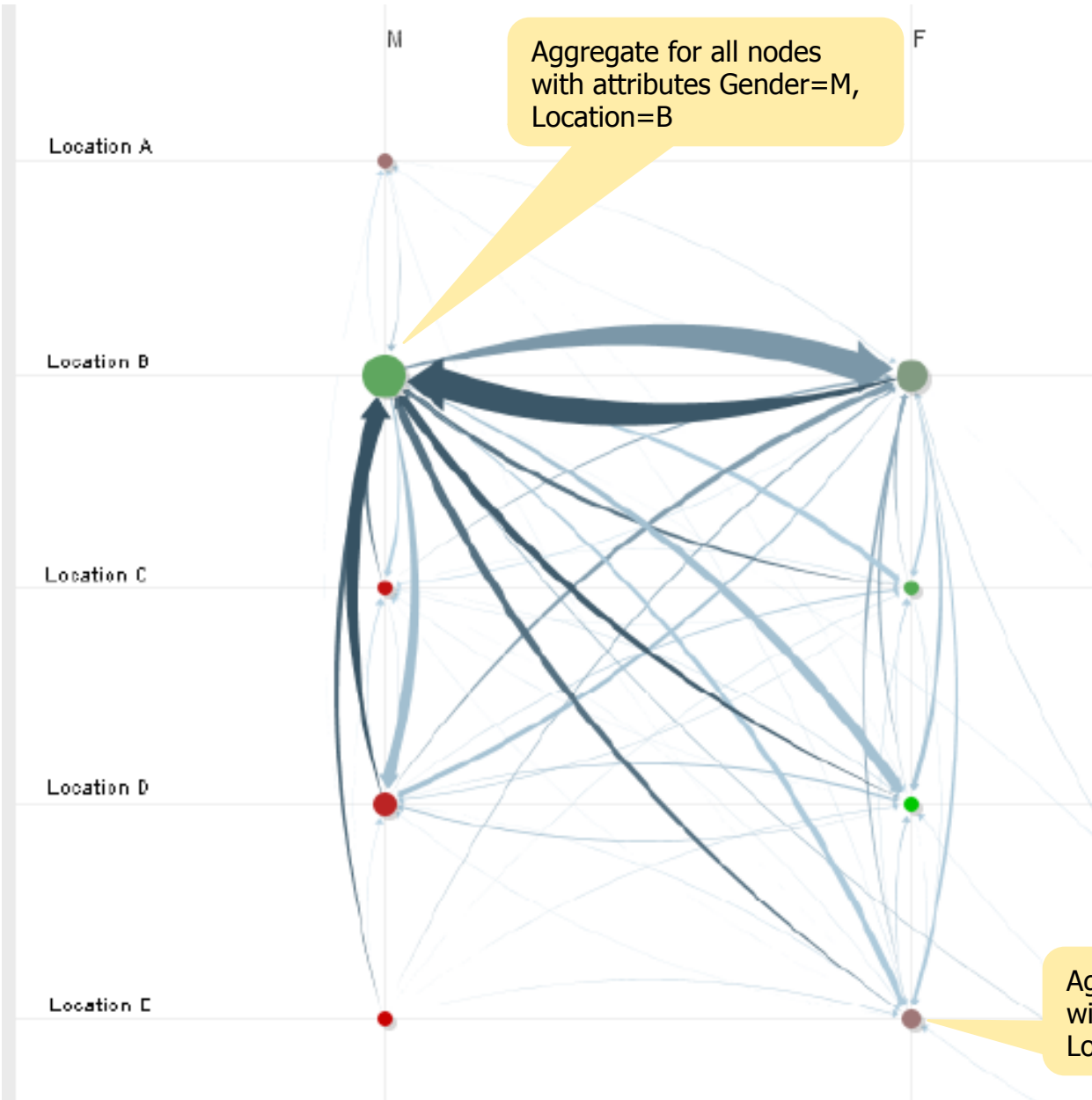
- Aggregate (cluster) network on common node attributes
 - Put all nodes of type A together, all B's together, ...
- “Roll up” nodes into
 - Draw edge from A to B depending on how many edges from some A to some B
- Position nodes into a grid based on attributes

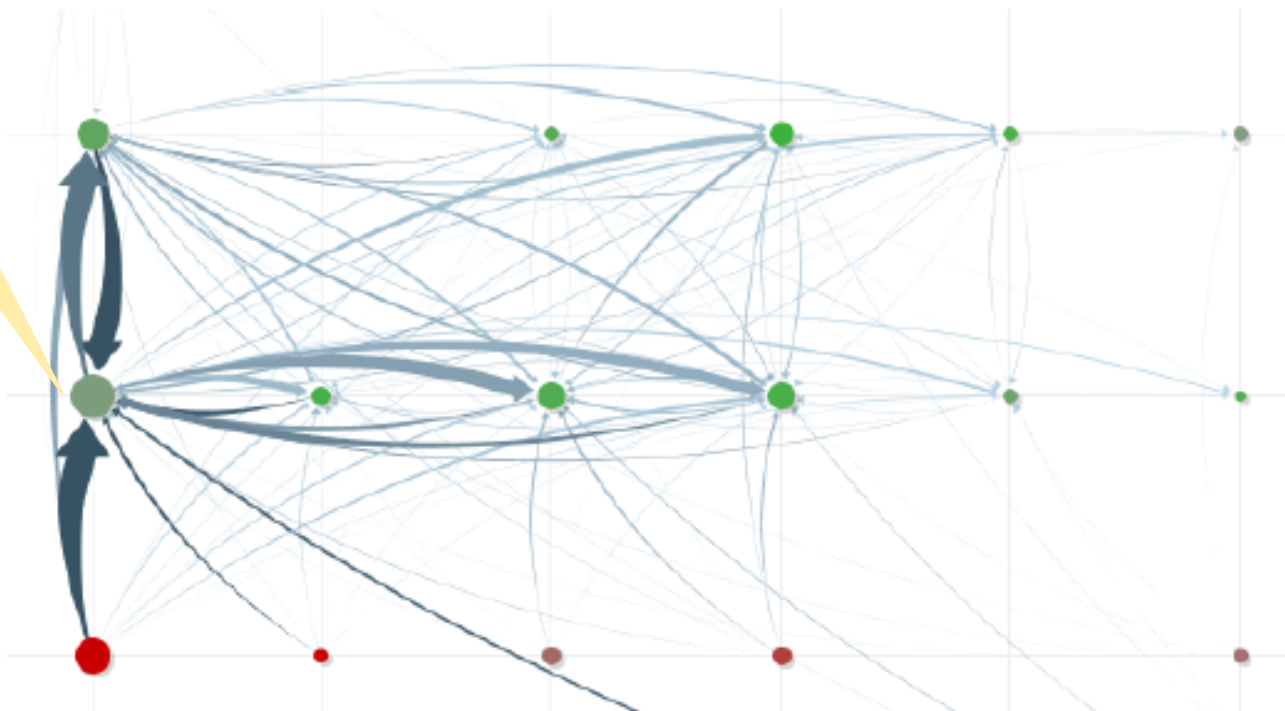
Wattenberg
CHI '06

Emails between employees, clustered by locations and gender.

Line thickness shows number of emails.

Much easier to interpret than network of all employees





Communications aggregated by 6 divisions (horizontal) and 3 locations (vertical).

Network Visualization by Semantic Substrates

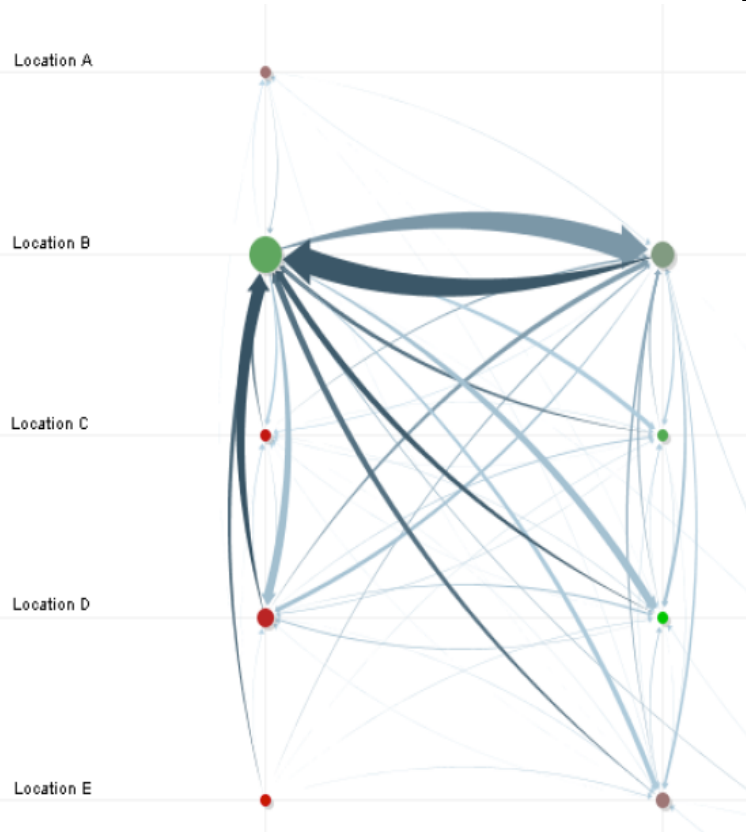
Ben Shneiderman and Aleks Aris
University of Maryland, HCIL

Copyright 2006

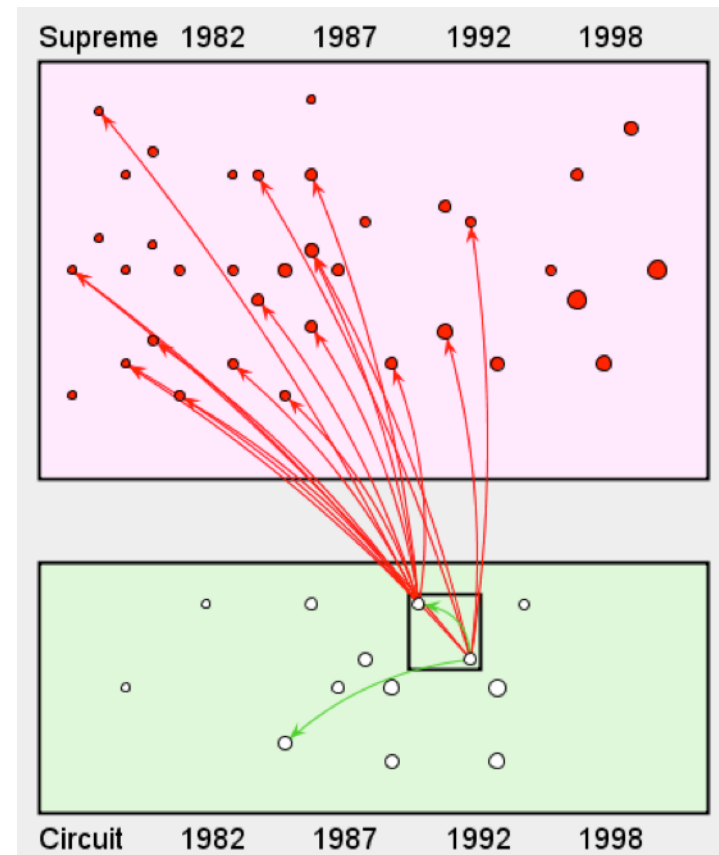
Discuss Differences with Neighbor



Pivot Graph (aggregate by common node attributes)



Semantic Substrates (segregate by common node attributes)



Comparison



Pivot Graph

- Uses node attributes
- Uses 1 or 2 node attributes
- Reduces number of nodes and links
- Scales well with network size
- One dimension similar to a substrate (see next slide)

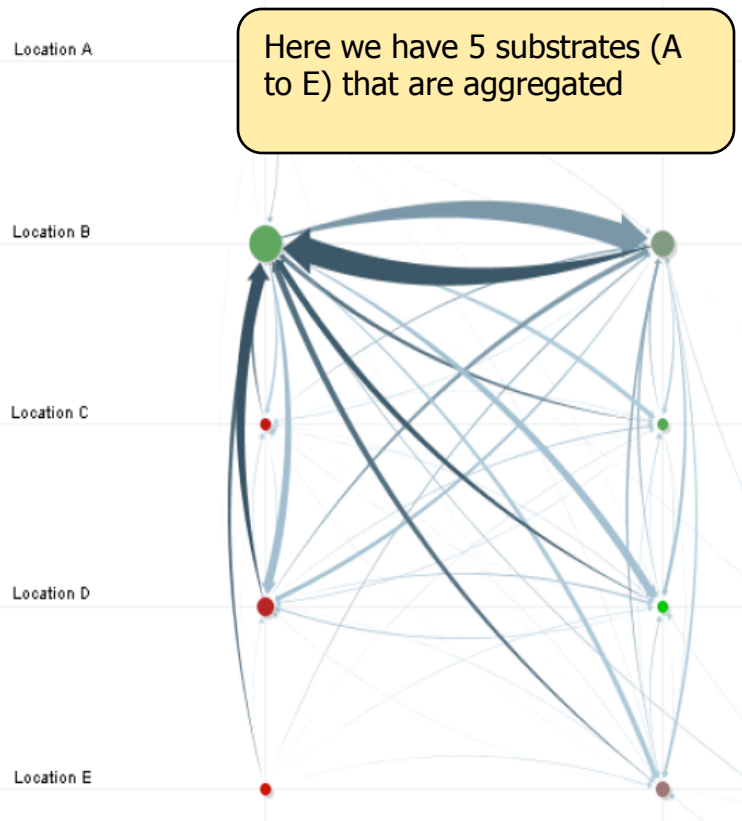
Semantic Substrates

- Uses node attributes
- Uses 1 node attribute
- Organizes nodes, does not reduce number
- Scales not as well with network size

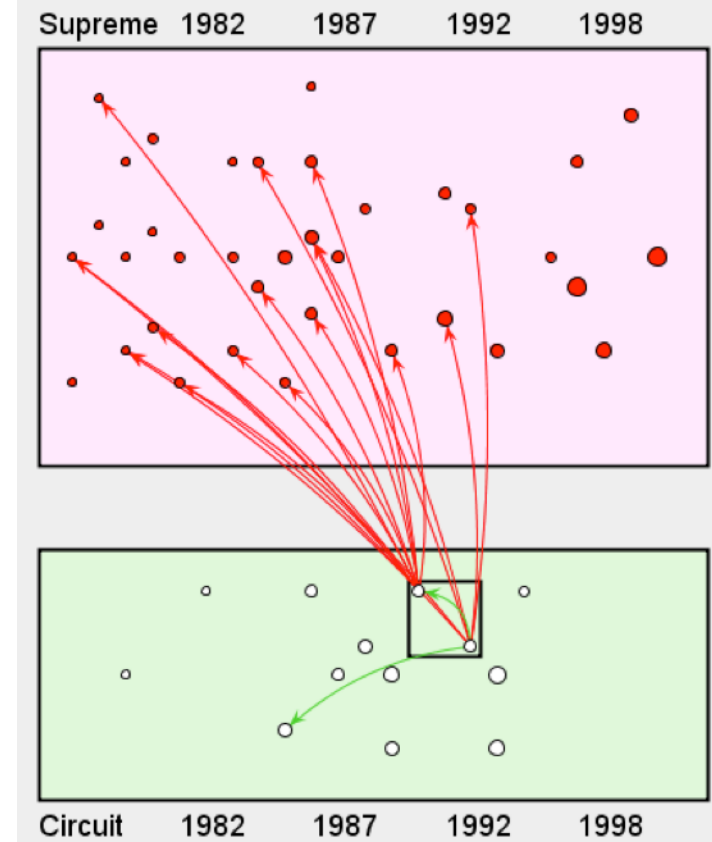
What Does Last Point Mean?



Pivot Graph (aggregate by common node attributes)



Semantic Substrates (segregate by common node attributes)



MatrixExplorer



- Provides matrix view in combination with node-link and various operations for gaining different perspectives

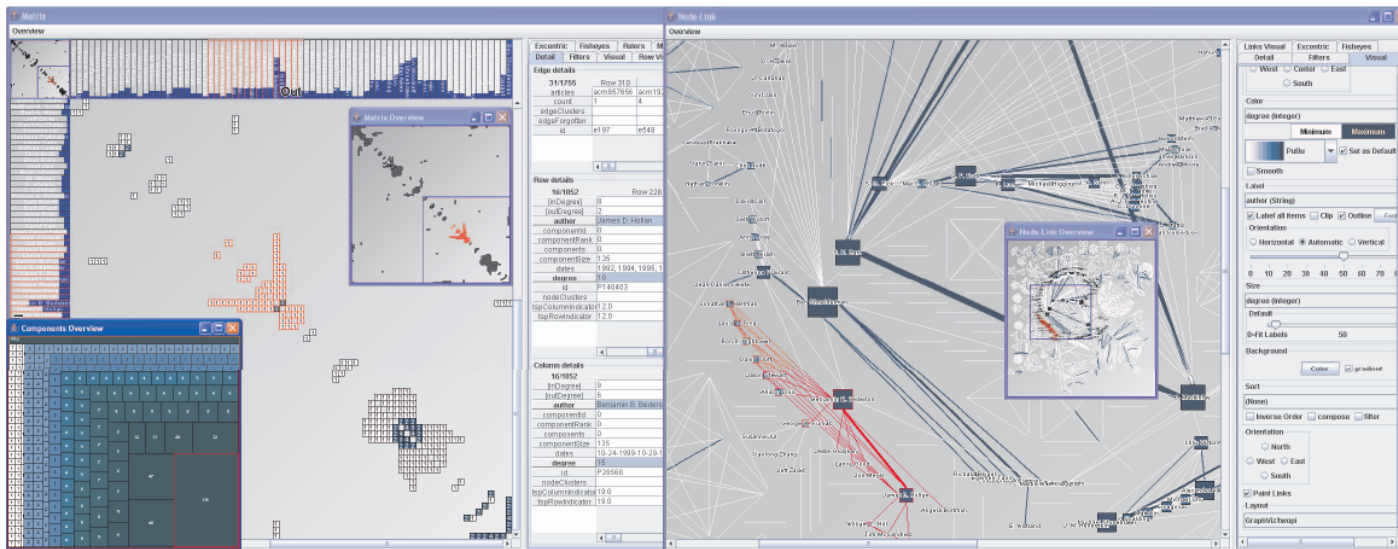


Fig. 1. MatrixExplorer showing two synchronized representations of the same network: matrix on the left and node-link on the right.

Edge Bundle

<http://bl.ocks.org/mbostock/7607999>

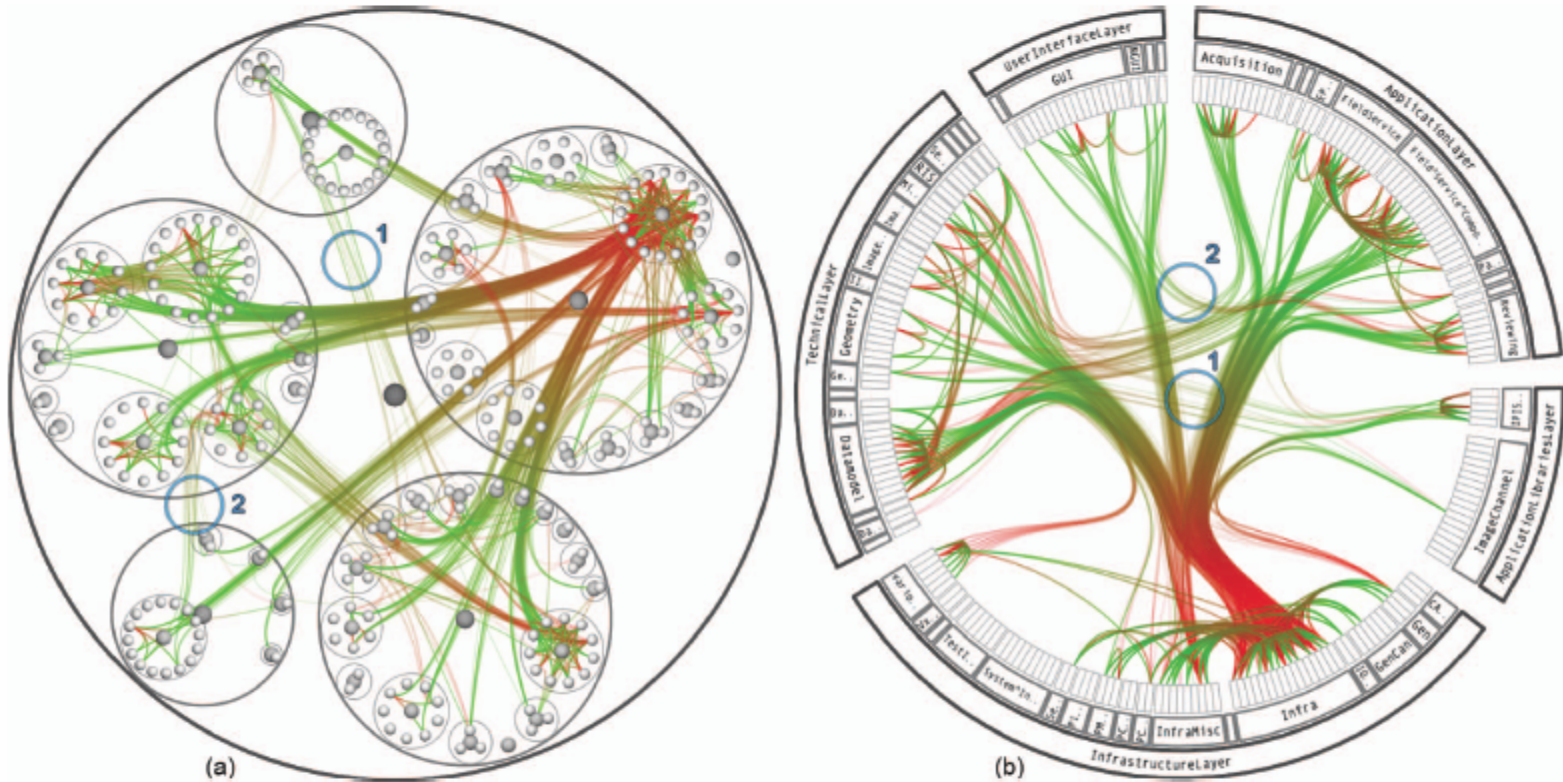


Fig. 13. A software system and its associated call graph (caller = green, callee = red). (a) and (b) show the system with bundling strength $\beta = 0.85$ using a balloon layout (node labels disabled) and a radial layout, respectively. Bundling reduces visual clutter, making it easier to perceive the actual connections than when compared to the non-bundled versions (figures 2a and 11a). Bundled visualizations also show relations between sparsely connected systems more clearly (encircled regions); these are almost completely obscured in the non-bundled versions. The encircled regions highlight identical parts of the system for (a), (b), and figure 15.

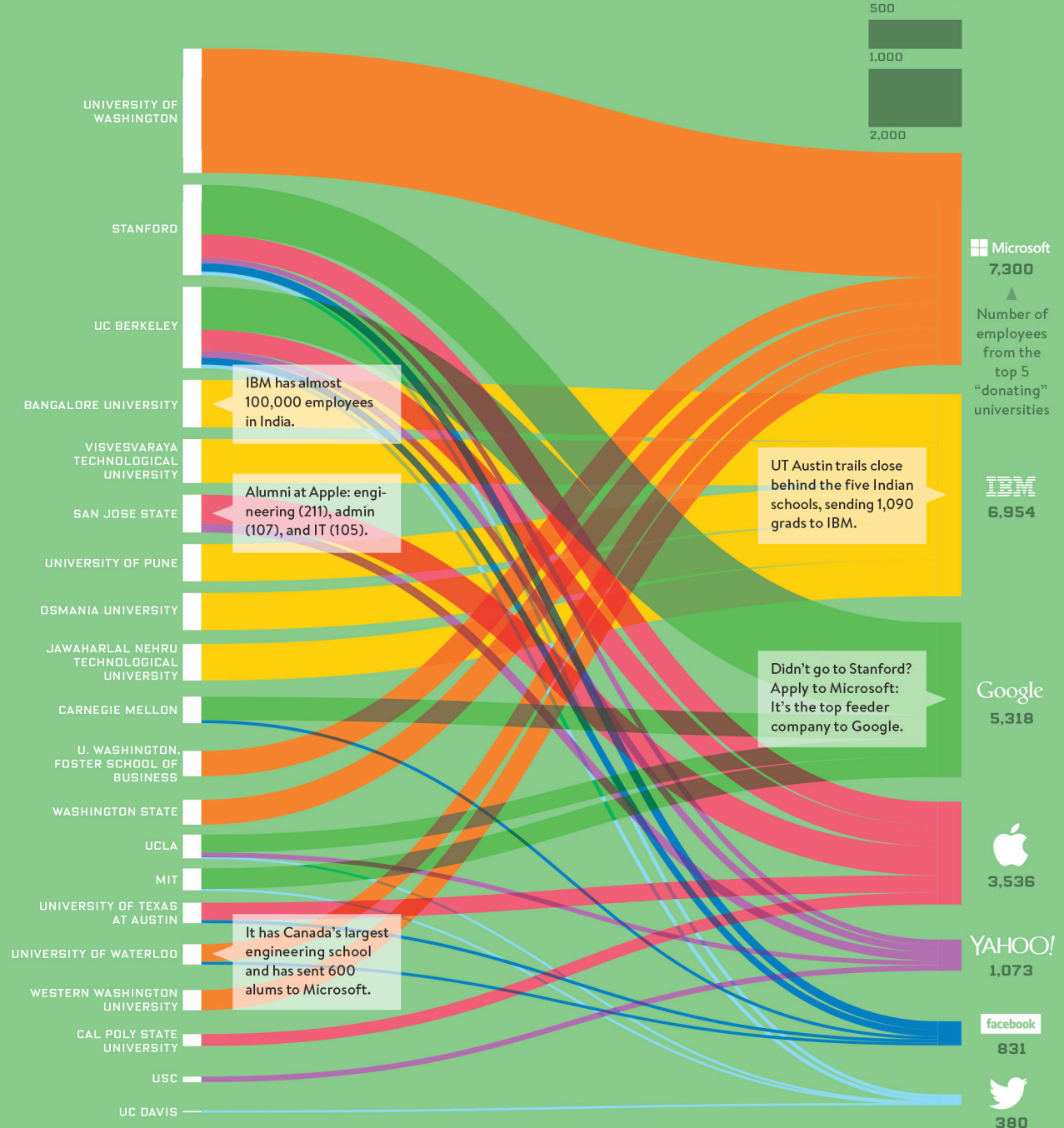
Flows from Schools to Companies

Different node types – schools and companies – is that OK?

Could this be extended to show flows from one company to another?

How many variables?

This is a *Sankey Diagram*



Wrap-up



- What is a network
- Ways to encode variables
- Ways to visualize networks
- Pros/cons of ways to visualize