

Data Visualization (CSCI 627/490)

Networks

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D3 Map Examples

Assignment 4

- Maps, colormaps, and treemaps
- Due in 2 weeks
- Color courselet will be available later today

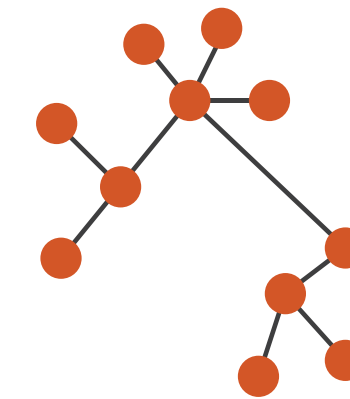
Networks

- Network: nodes and edges connecting the nodes
- Formally, $G = (V, E)$ is a set of nodes V and a set of edges E where each edge connects two nodes.
- Nodes == items, edges connect items
- **Both** nodes and edges may have **attributes**

Arrange Networks and Trees

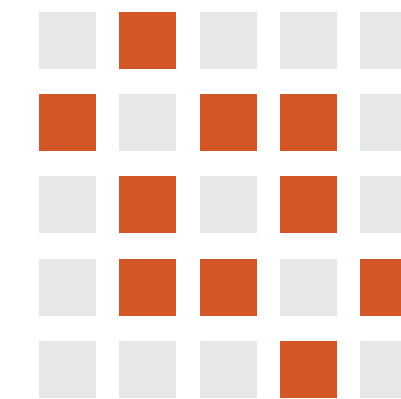
➔ Node-Link Diagrams Connection Marks

✓ NETWORKS ✓ TREES



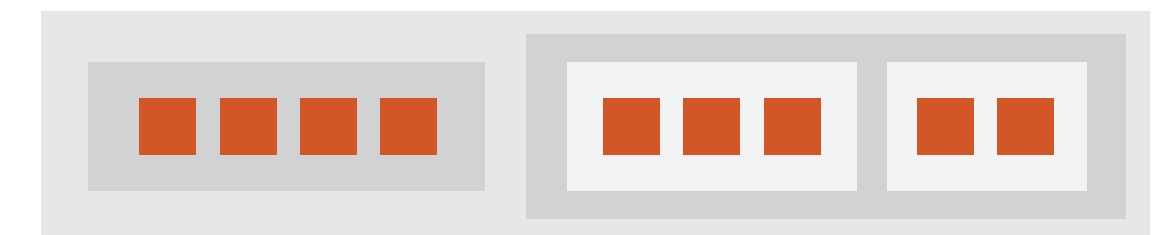
➔ Adjacency Matrix Derived Table

✓ NETWORKS ✓ TREES



➔ Enclosure Containment Marks

✗ NETWORKS ✓ TREES



[Munzner (ill. Maguire), 2014]

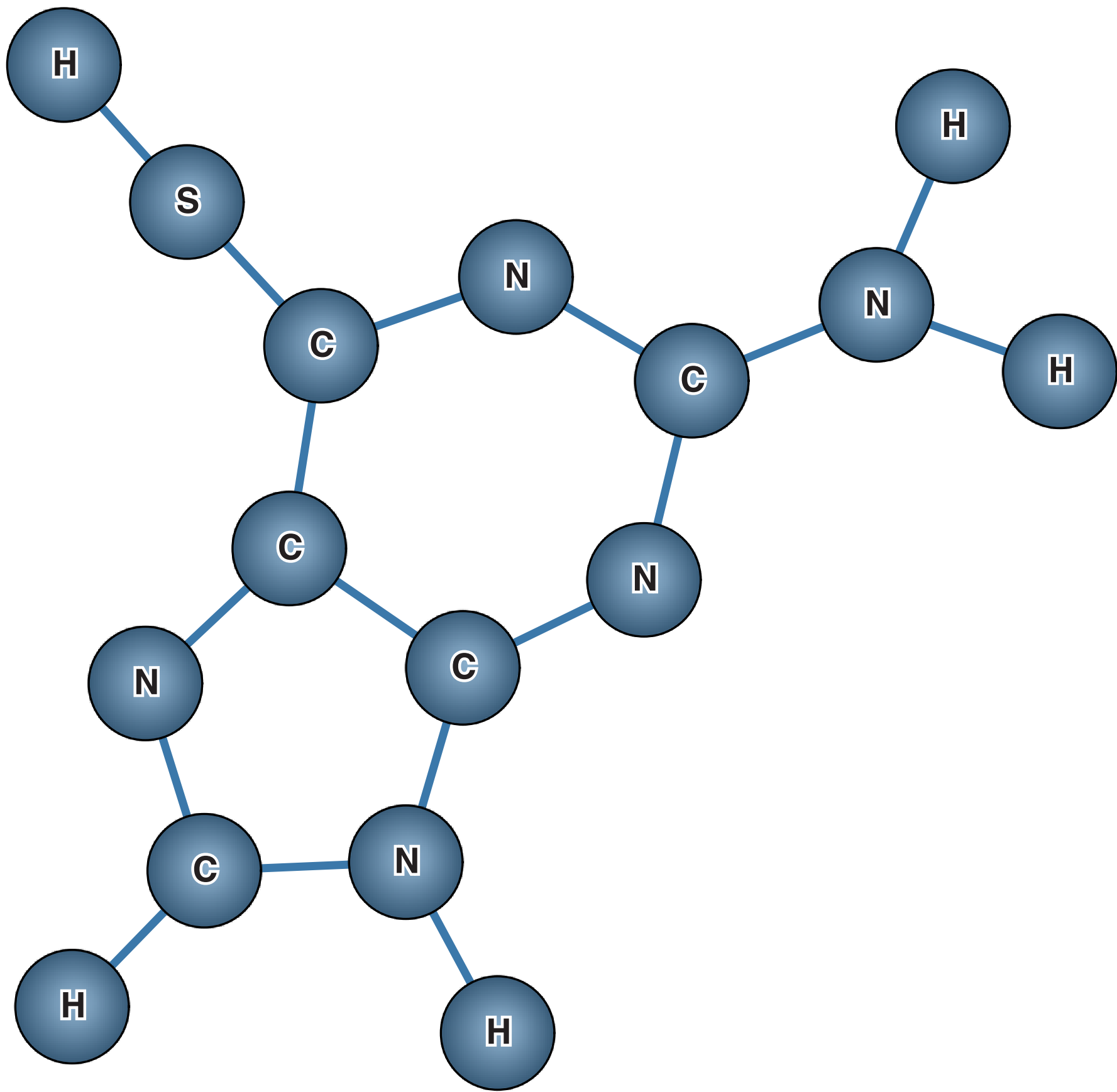
Network Data Represented in Tables

Nodes

ID	Atom	Electrons	Protons
0	N	7	7
1	C	6	6
2	S	16	16
3	C	6	6
4	N	7	7

Edges

ID1	ID2	Bonds
0	1	1
1	2	1
1	3	2
3	4	1

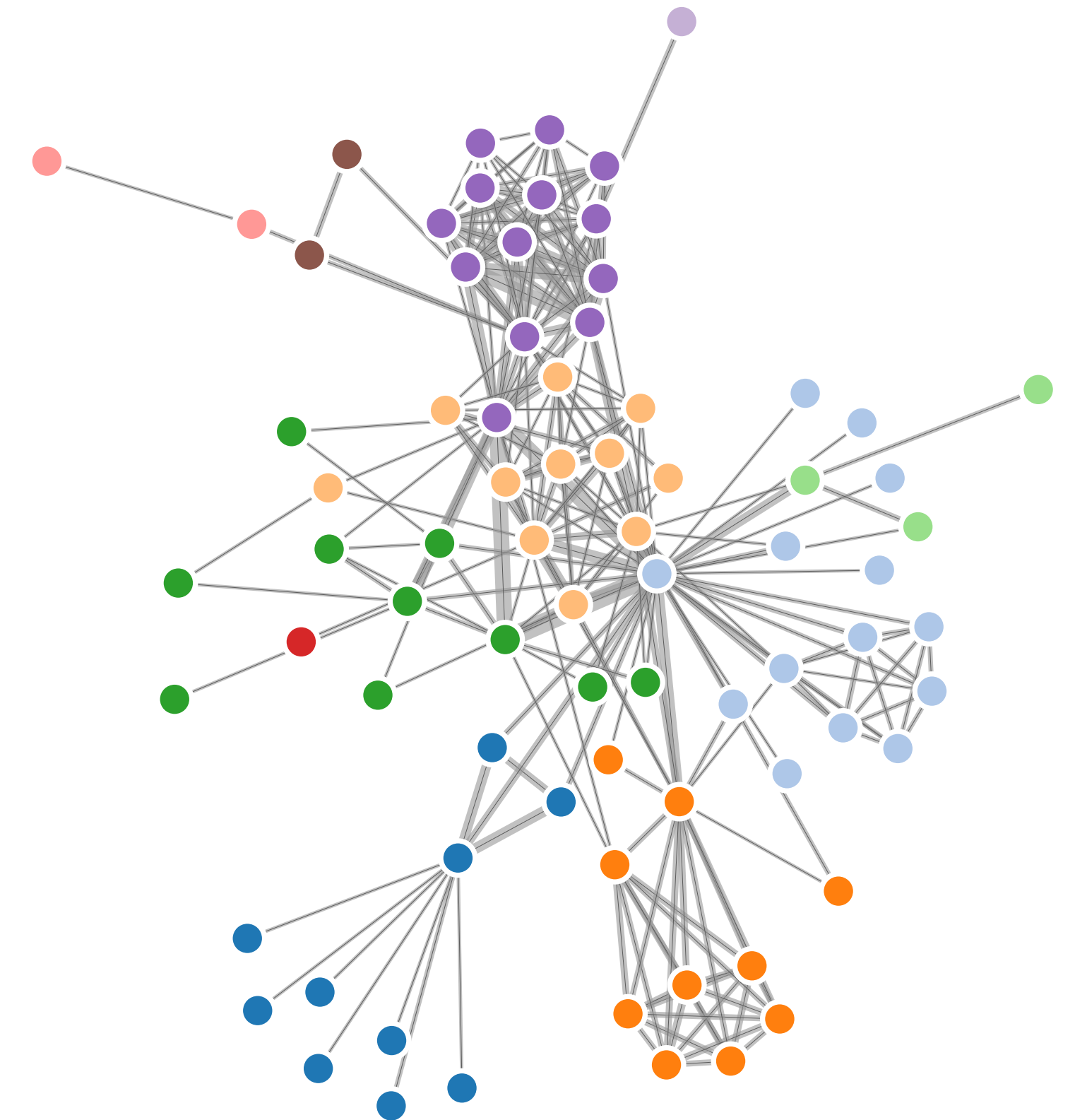


Networks Need Layouts!

- Need to use spatial position when designing network visualizations
- Otherwise, nodes can **occlude** each other, links hard to distinguish
- How?
 - With bar charts, we could order using an attribute...
 - With networks, we want to be able to see connectivity and topology (not in the data usually)
- Possible metrics:
 - Edge crossings
 - Node overlaps
 - Total area

Force-Directed Layout

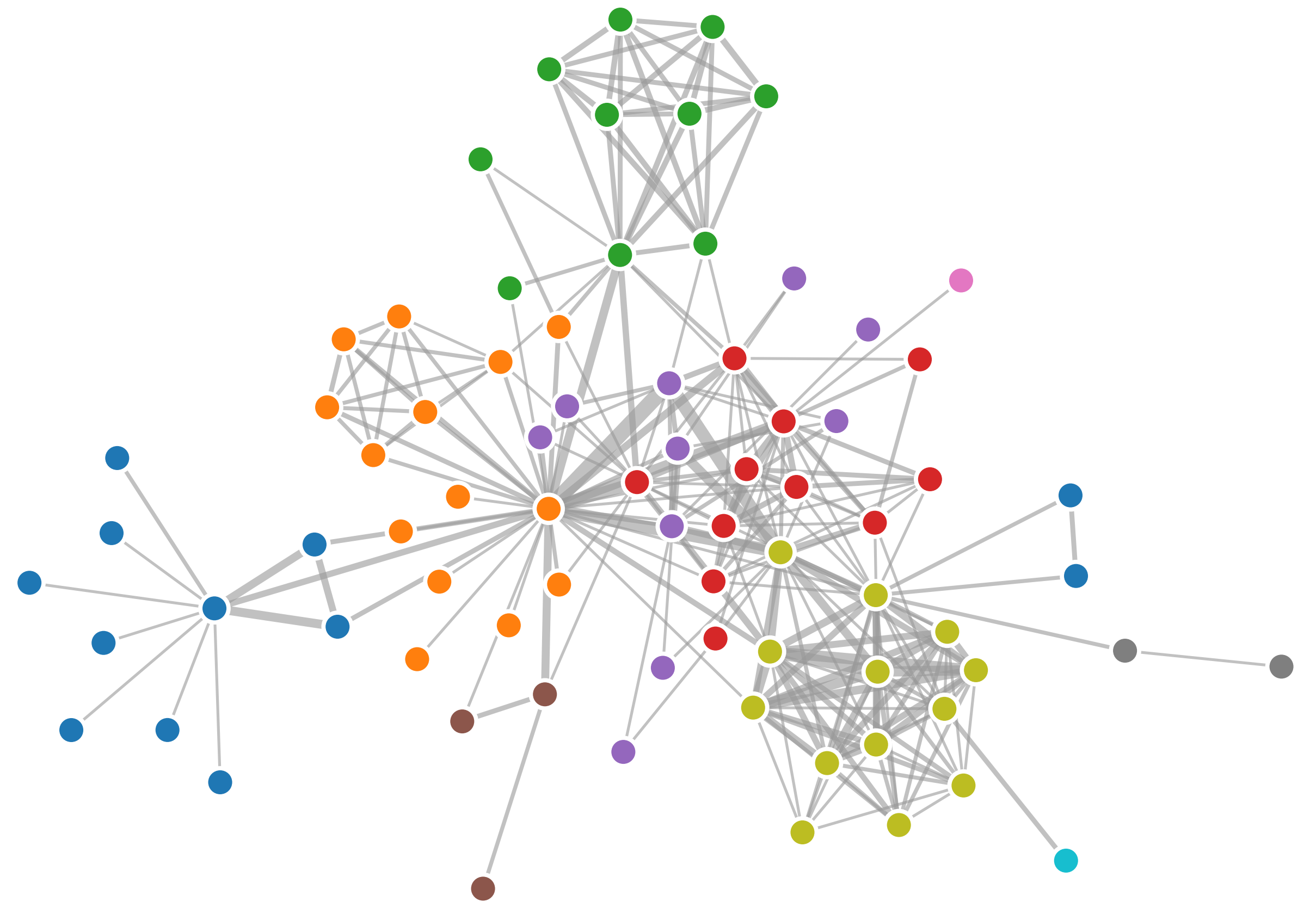
- Nodes push away from each other but edges are springs that pull them together
- Weakness: nondeterminism, algorithm may produce different results each time it runs



[M. Bostock, 2017]

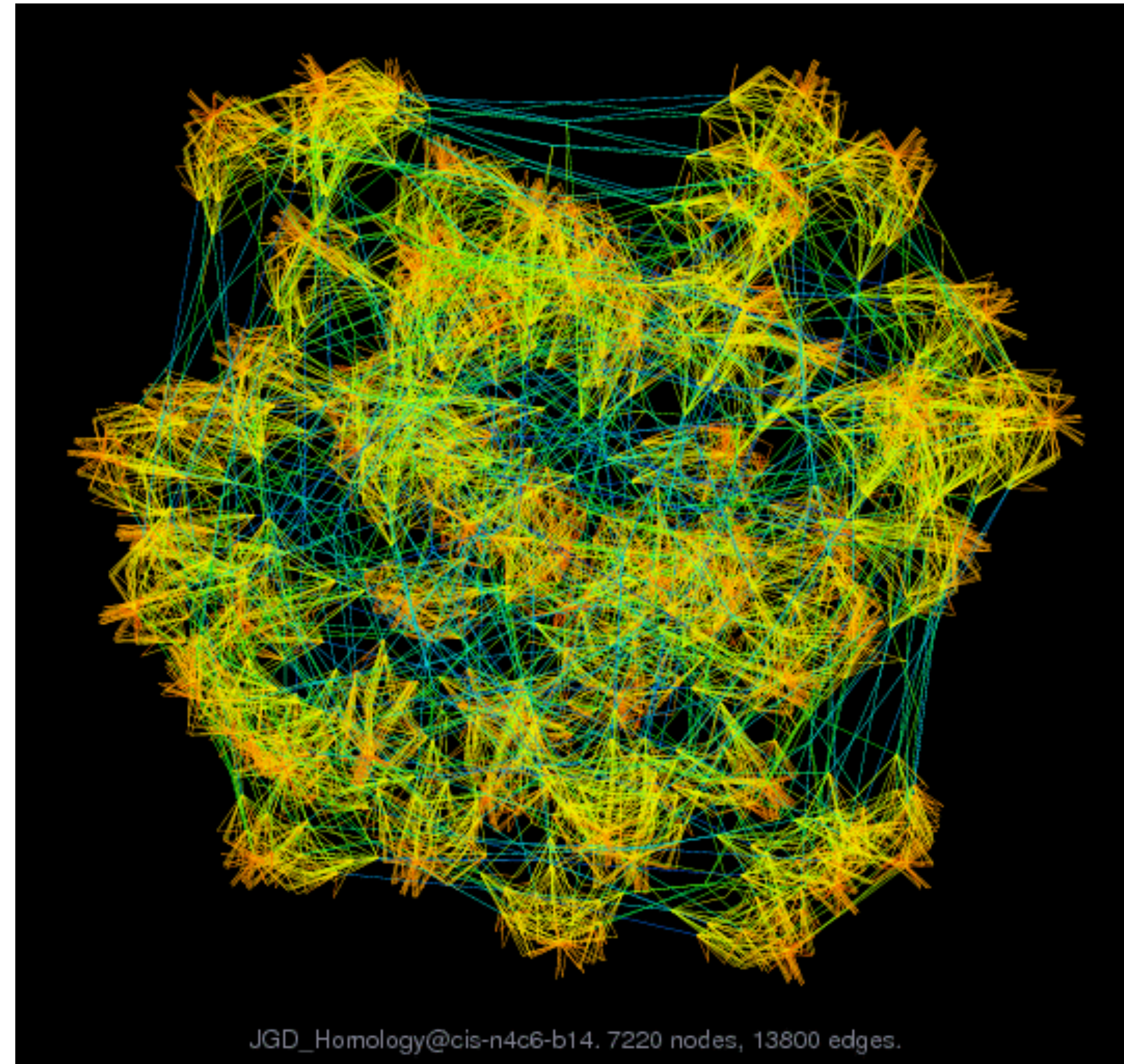
Constraint-Based Optimization (CoLa)

- Higher quality layout
- More **stable** in interactive applications (no "jitter")
- Allows user specified constraints such as alignments and grouping
- Can avoid overlapping nodes
- Provides flow layout for directed graphs
- May be **less scalable** to very large graphs
- Can route edges around nodes



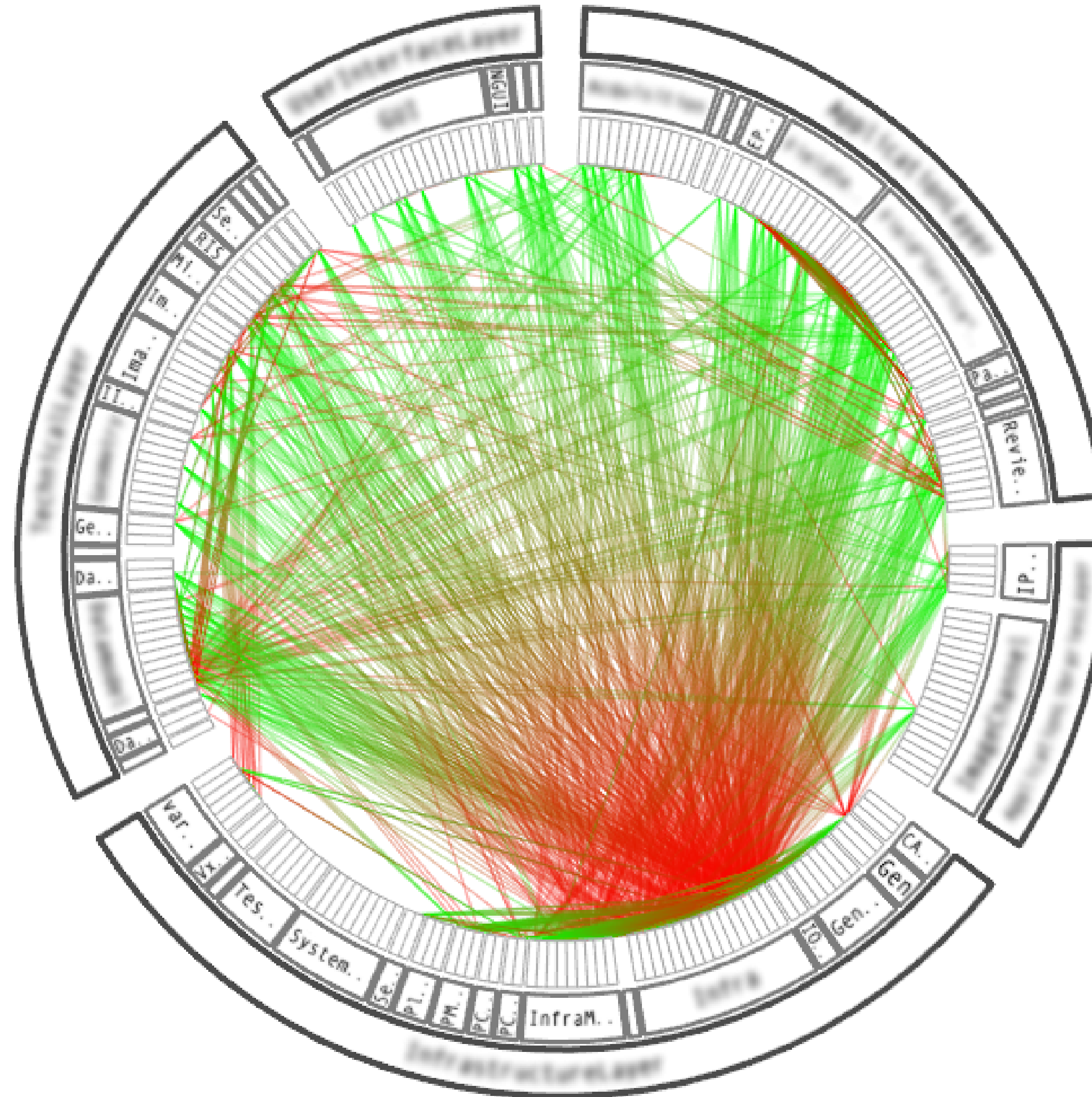
[T. Dwyer et al. (WebCoLa); M. Bostock (Example), 2018]

sfdp



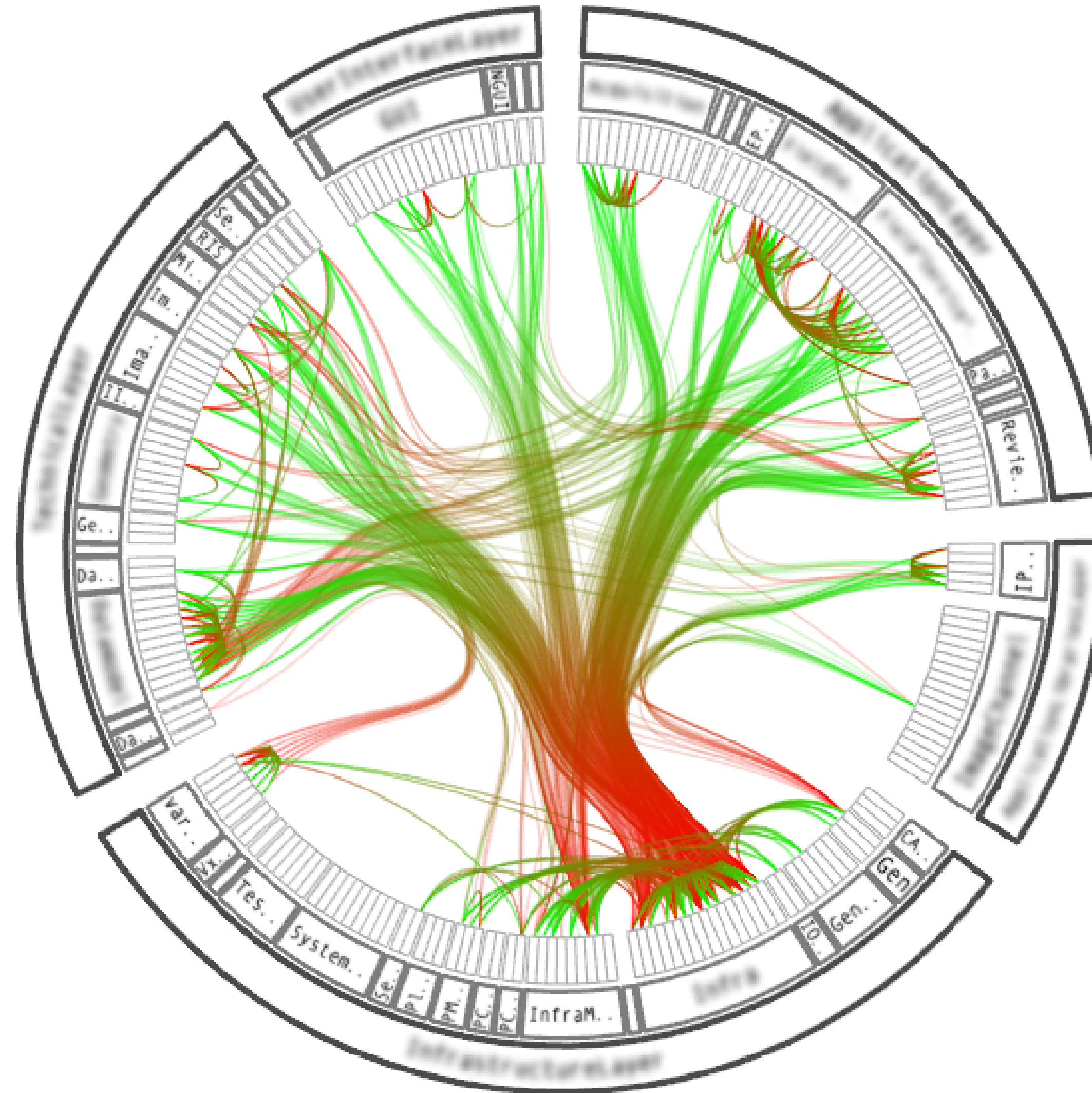
[Hu, 2005]

Hierarchical Edge Bundling



[Holten, 2006]

Hierarchical Edge Bundling



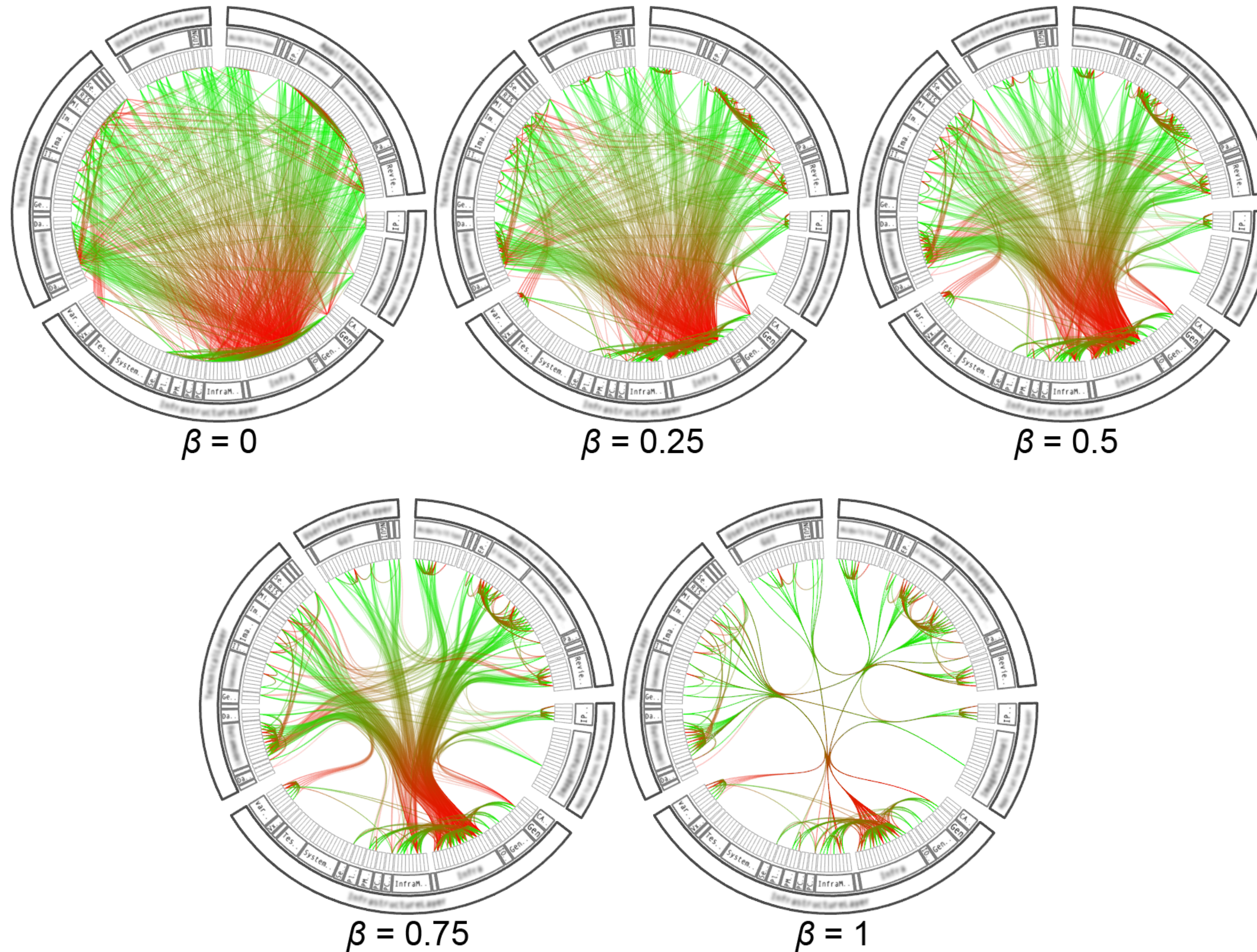
[Holten, 2006]

Hierarchical Edge Bundling

- Flexible and generic method
- Reduces visual clutter when dealing with large numbers of adjacency edges
- Provides an intuitive and continuous way to control the strength of bundling.
 - Low bundling strength mainly provides low-level, node-to-node connectivity information
 - High bundling strength provides high-level information as well by implicit visualization of adjacency edges between parent nodes that are the result of explicit adjacency edges between their respective child nodes

[Holten, 2006]

Bundling Strength



[Holten, 2006]

Guest Lecture

Dr. Lei Zhang
Northern Illinois University