Graph Visualization

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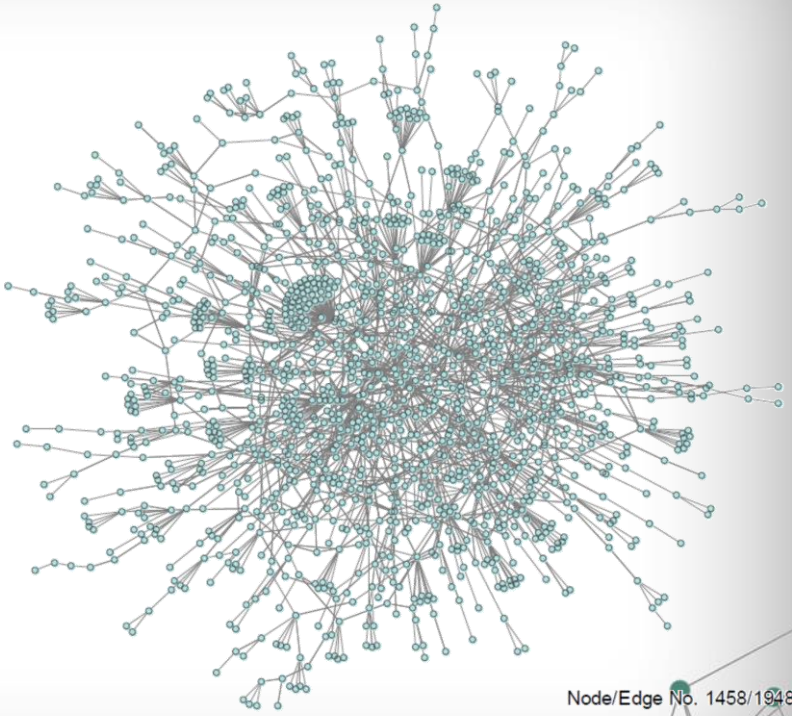
GEM Force Directed Layout

- Edges exert spring force on their nodes
  - preset globally uniform desired edge length
  - spring force diminished by node degree, making higher degree nodes “heavier”
- Nodes mutually repel each other
  - strength ≈ 1/distance
- All nodes experience global forces
  - gravitational force toward center
  - small random perturbation force

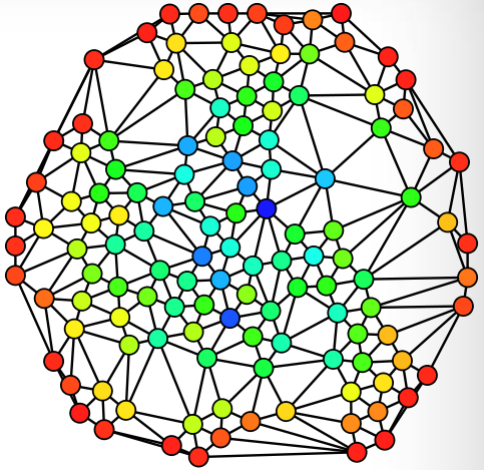


yeast protein interactions

Frick, Ludwig & Mehldau. A Fast Adaptive Layout Algorithm for Undirected Graphs. Proc. Graph Drawing, 1994.

Centralities

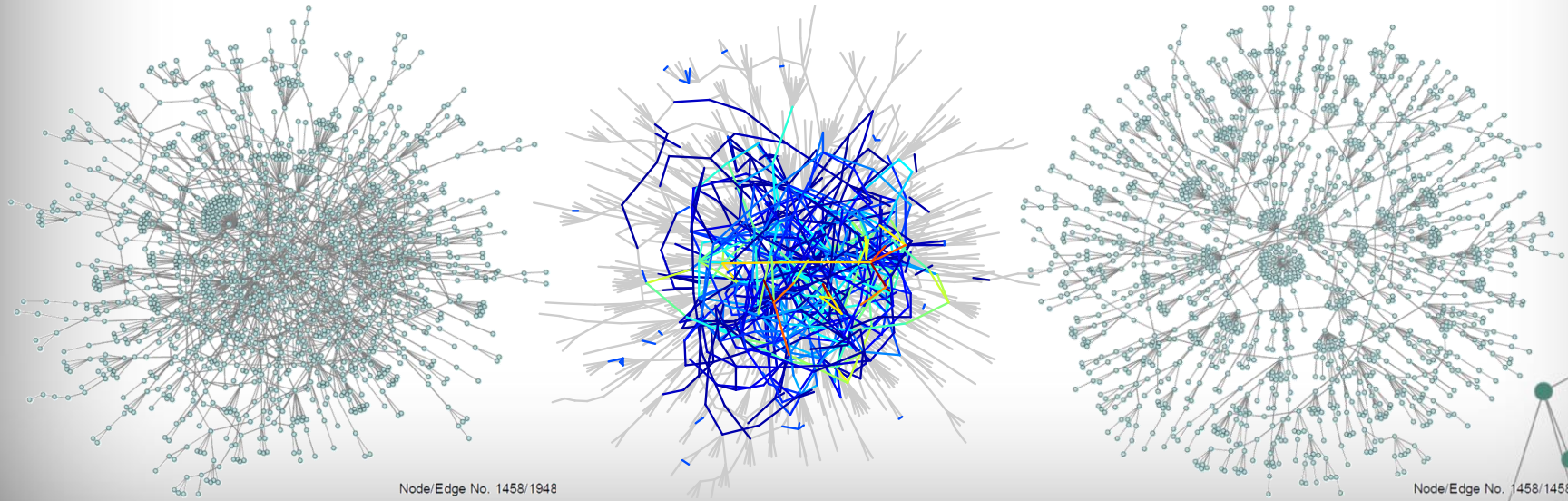
- Node degree is a simple centrality measure
  - high degree nodes better connected than low degree nodes
  - PageRank: sum of PageRanks of incoming links
- Isolation metric is total distance to all other nodes
  - Closeness centrality = 1/isolation metric
  - Graph centrality = 1/distance to the farthest node
- Betweenness centrality of a node
  - portion of all shortest paths between any two nodes that pass through the given node
  - Can also compute for an edge



red = low BC, blue = high BC

Simplification

- Removing lowest BC edges that don't disconnect graph results in a tree shaped "backbone"
- Simplifies force-directed layout, then can later add less significant edges back in

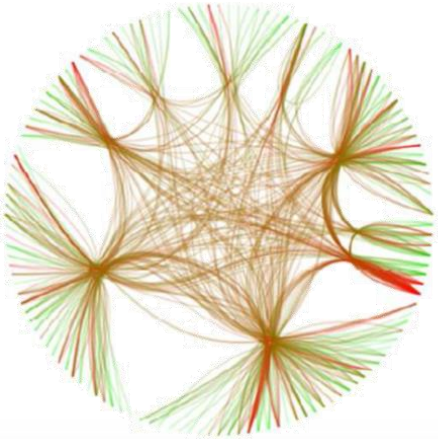


Edge Bundles

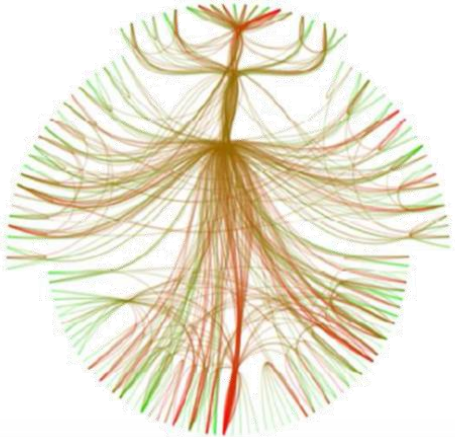
Holten. Hierarchical edge bundles: Visualization of adjacency relations in hierarchical data. IEEE TVCG 12(5), 2006, pp. 741–748

- Aggregate “similar” edges into “wire bundles” to simplify presentation
- Will need measure of edge similarity

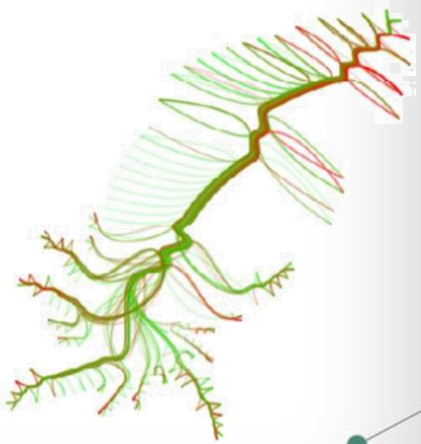
389 Enron emails between 132 employees on 8/2001



radial layout



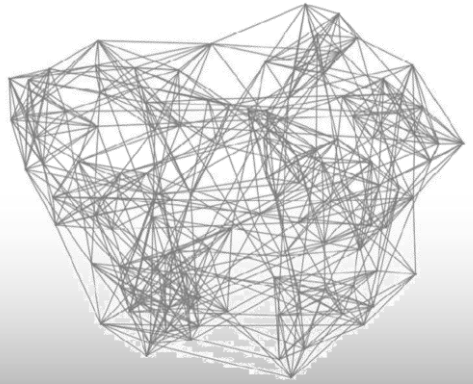
“small worlds” layout

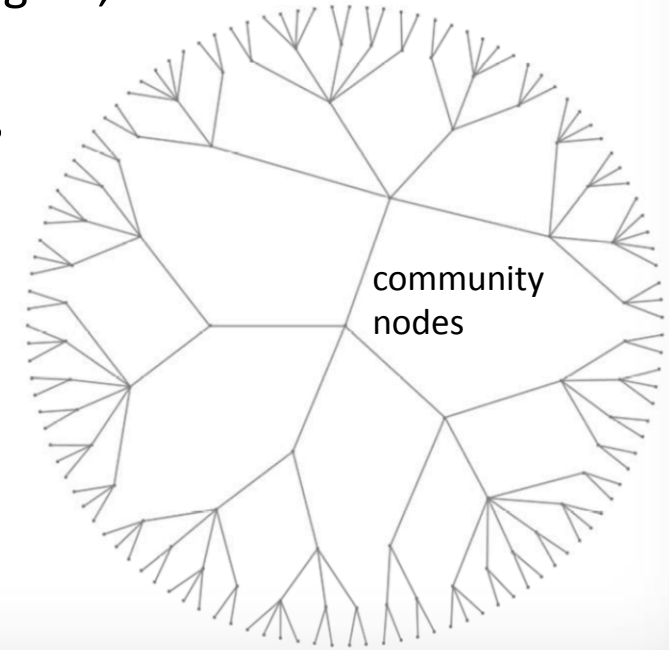


force-directed layout

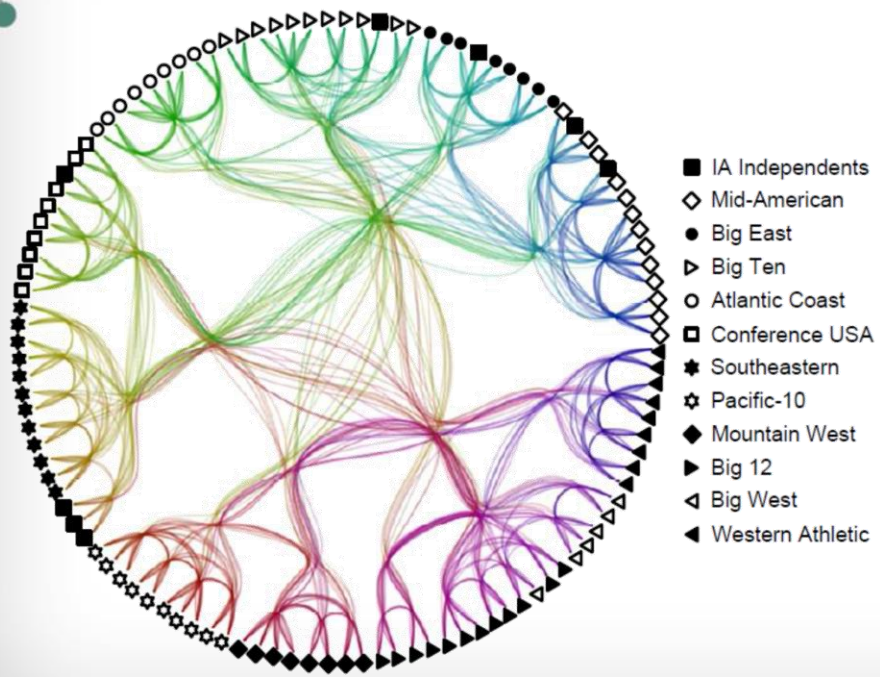
Community Discovery

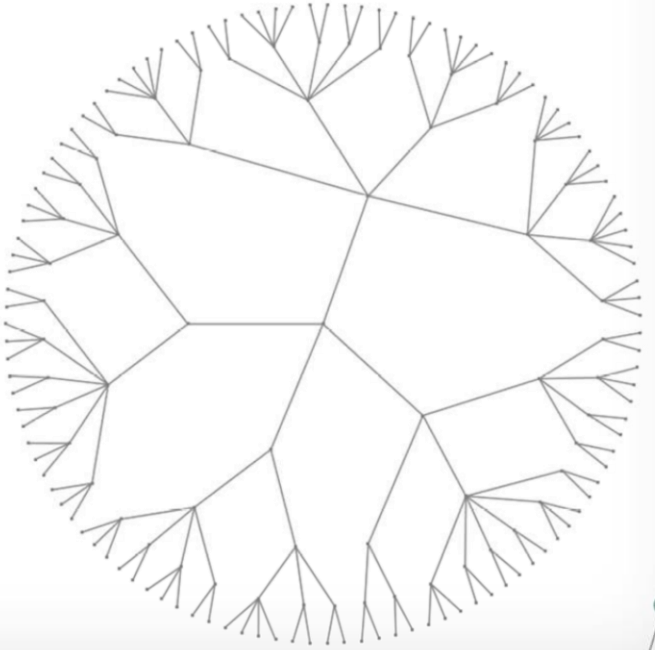
- Remove edges in order of decreasing BC, from highest to lowest
- At lowest level reveals communities
- Creates community hierarchies as higher BC edges merge lower-level communities



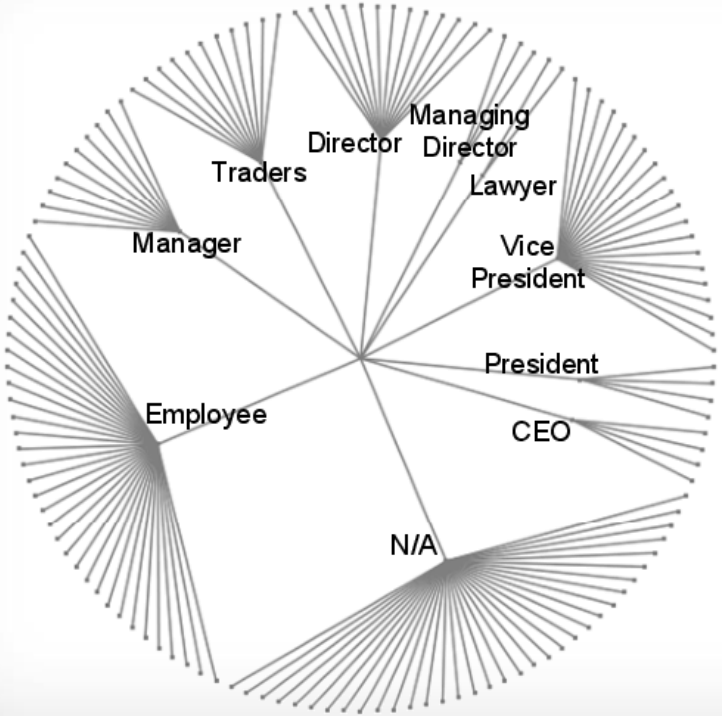


Edge Bundle Communities





Enron



actual communities

discovered communities

Filtering & Details