VISUALIZATION

UNIT - V

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Introduction

- Visualization powerful technique for exploring social relationships in social networks
- Earlier methods - hand drawn images, computational methods (Factor analysis, multidimensional scaling), lay out nodes in a 2D or 3D
- Evolved to machine-drawn images and screen-oriented graphics
- Displaying fine graph layouts, coloring, presenting node-edge relations, visualizing complex relations is still challenging
- Moreno – developed sociograms to represent social networks - to explore social relations in a formal study

Graph Theory

- Concepts and metrics in SNA are derived from graph theory

- Node degree: number of edges incident to the node, for loops counted twice
  - At most for undirected graph: N * (N-1) /2
  - At most for directed graph: N * (N-1), where ‘N’ no. of nodes

- Node density:
- Density of an undirected graph can be defined as (2 *E) / N * (N -1) where E is number of edges
- Density of a directed graph can be E / N * (N -1)

Contd...

- Path length: distances between pairs of nodes in a network graph
- Average path length - is the average of these distances between all pairs of nodes
- Component size: counted by the number of connected nodes in a graph
- if a graph is not connected, the graph can be partitioned into several connected subgraphs
- Component size of each subgraph can be calculated by the number of connected nodes in each subgraph.

Centrality

- Identify the most important or central nodes in the network
- HITS and PageRank algorithm are two most famous representatives using centrality for ranking
- HITS - analyzes important nodes based on calculating Authorities (indegrees) and Hubs (out-degrees)
- PageRank calculates node values based on out-degrees
- In social network analysis, three most popularly adopted methods to measure the centrality:
- “Degree”, “Betweenness”, and “Closeness”

Contd...

- Degree centrality: number of edges incident upon a node
  - Centrality is computed for the nodes that have direct connections
  - If the edges are directed, in-degree centrality is differentiated from out-degree centrality
- Betweenness centrality: Computes the extent to which a node lies between other nodes in the network
  - Gives higher value for nodes which bridge clusters
  - It also reflects the number of nodes which a node is connecting indirectly through the direct links

Contd...

- Closeness centrality: is a measure of the order of magnitude that a node is near to all other nodes
  - Calculating by finding mean shortest path for a node to all other nodes
  - Highly ranked with closeness centrality acts as information distributors in social network

Clustering

- In social networks, subsets of nodes highly connected within subset and have relatively few connections to nodes outside the subset
- Such subsets are likely to share some attributes and form their own communities
- Efficient and effective discover such community structures is important
- Important measure to help explore the grouping effects is clustering coefficient
- Clustering Coefficient: measure the degrees of nodes to decide which nodes in a graph tend to be clustered together
  - It is utilized for small world analysis

Visualization

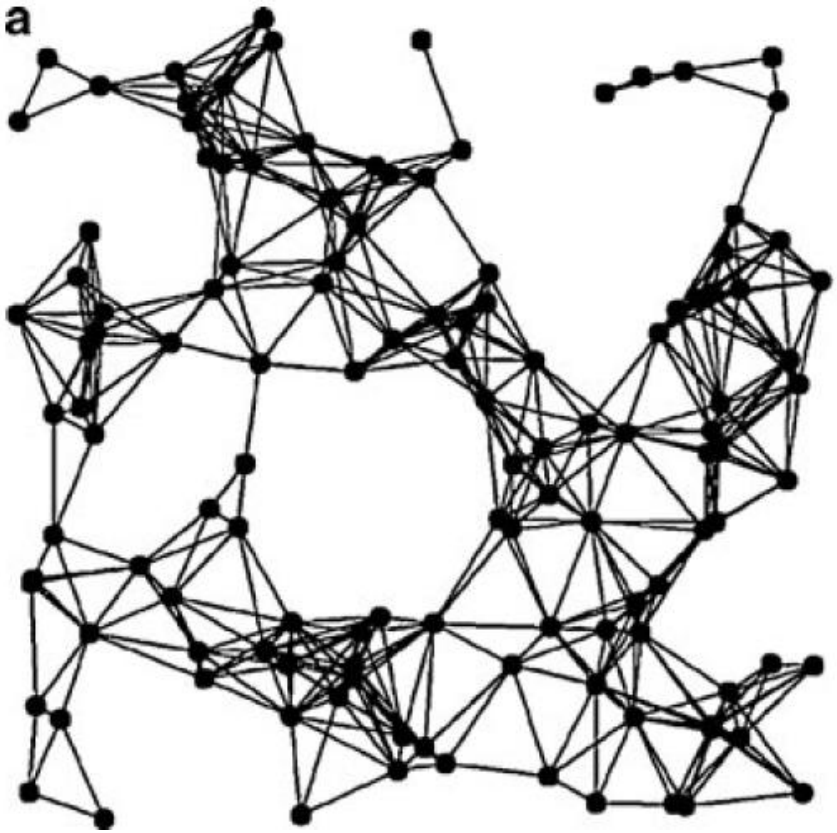
- Visualization plays crucial role of linking human vision and computer
- Helps to identify patterns, extracting insights from large amounts of information
- Help to understand different information structures, various visual representations and metaphors
- Single visualization method cannot fit all kinds of information structures
- Popularly employed visual representations – node-edge diagrams and matrix representations

Node – Edge Diagrams

- An intuitive way to visualize social networks
- It can better present for many network analysis tasks - component size calculation, centrality analysis, and pattern sketching
- Many node-edge layouts have been presented based on size, complexity, and structure of the social network
- Three kinds of layouts for Node-Edge Diagrams - random layout, force-directed layout, and tree layout

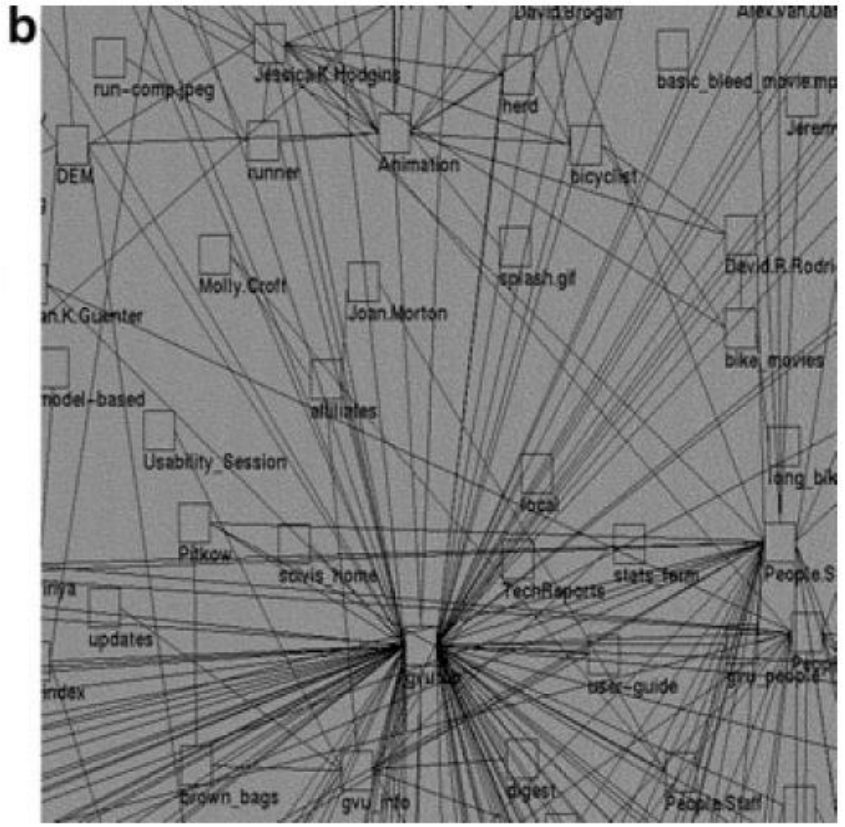
Random Layout

- Put the nodes at random geometric locations in the graph
- Don’t have clear visualization for more than thousands of nodes
- Can efficiently draw the social network graph in linear time O(N)
- Sometimes it can be usable to visualize very large network graphs



Force-Directed Layout

- Edges act as spring and the nodes act as repelling objects (Edge attraction and vertex repulsion)
- Mimics Hooke's law and the Coulomb's law
- Initial random layout yielded first
- force-directed algorithms run iteratively to adjust the positions of nodes
- Performed till all graph nodes and attractive forces between the adjacent nodes run to convergence



Force-Directed Layout Contd...

- Force-based graph layout forms better layouts of the space
- Running cost is much higher than that of a random layout [O (N log N or O (E)]
- Not suitable for graphs larger than hundreds of nodes

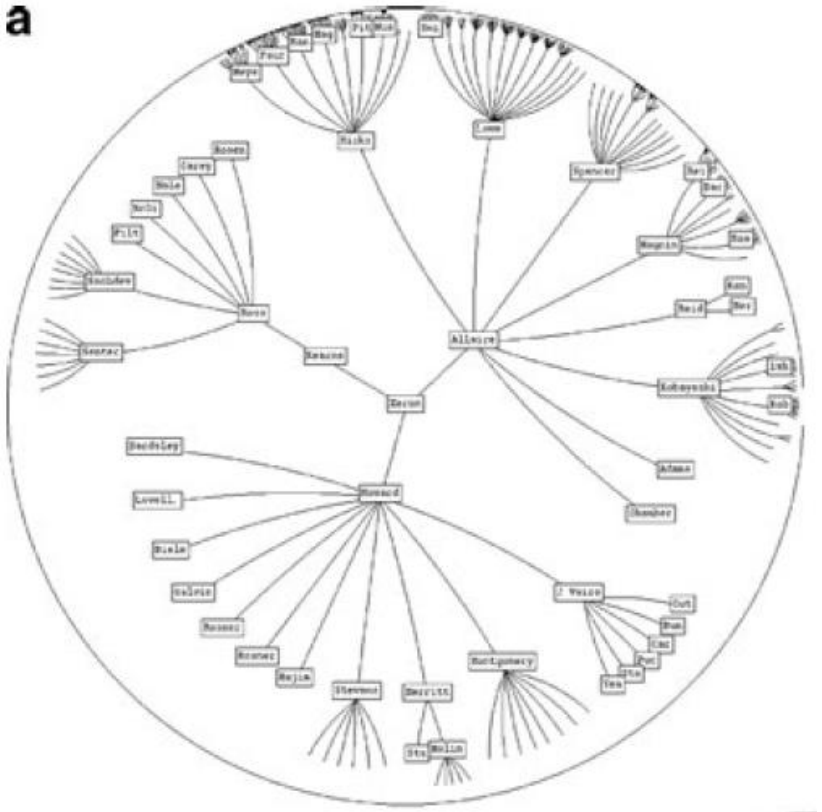
Tree Layout

- Basic Layout, chooses a node as root, nodes connected to it become children, nodes at more levels from root become grand-children so on
- Displays more structural layout than graph considering more contextual information
- Trees are more straightforward to grasp human eye than general graphs
- Special cases takes more constraints
- More contextual information can be extracted - facilitates network analysis

Tree Layout Contd...

- Domain specific variants of tree layout - hyperbolic tree layout, radial tree layout
- tree visualizations utilize idea of focus + context + animation techniques for better visualization
- Help users to obtain both global and local views in 2D display

Hyperbolic Tree View



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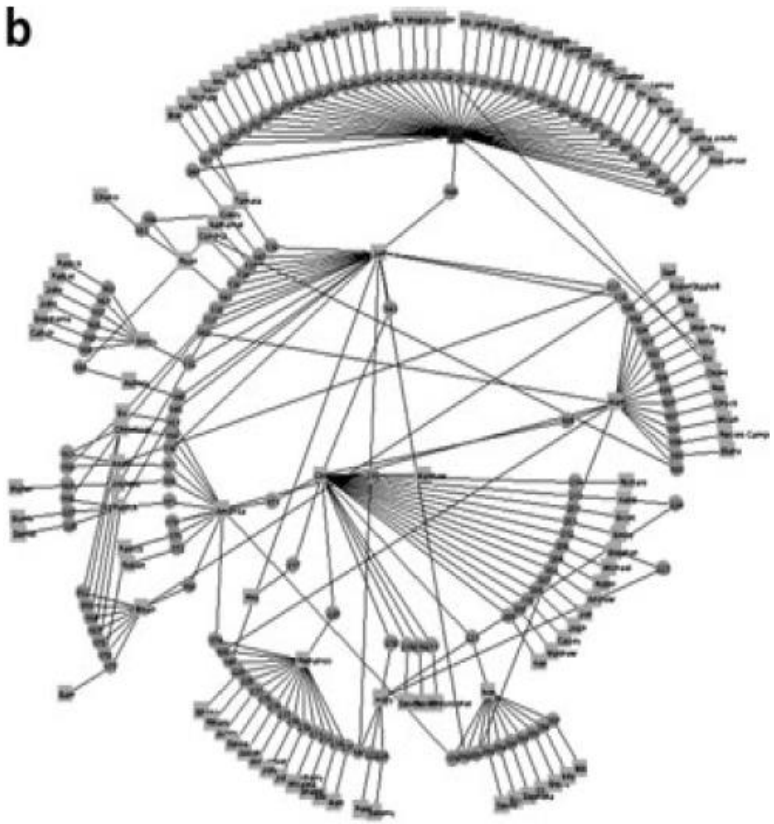
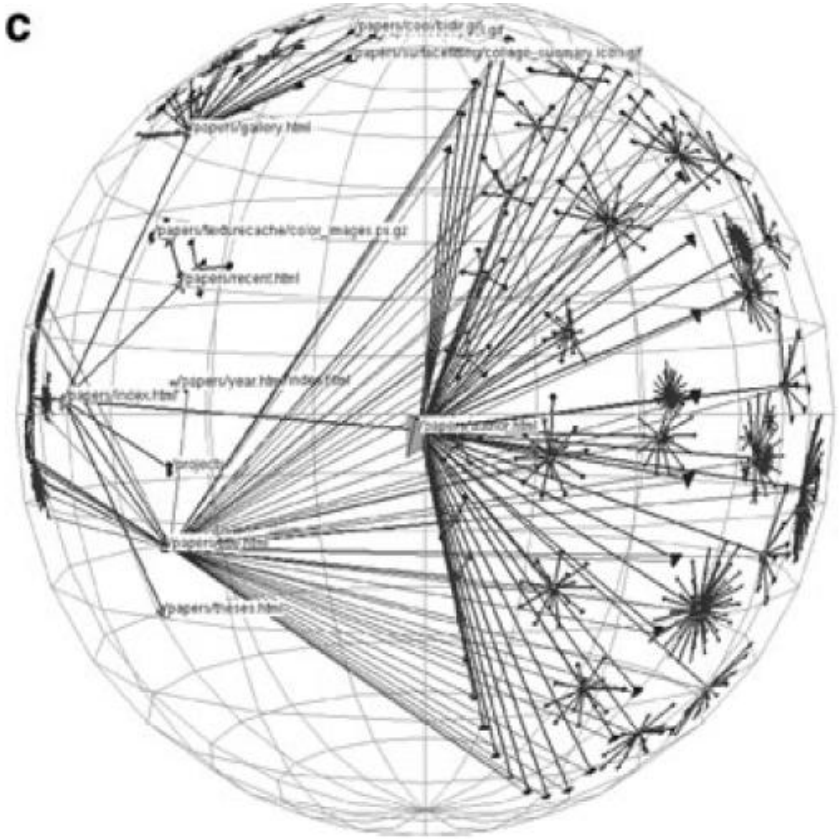
Radial Tree Layout



H3 Visualization



Matrix Representation

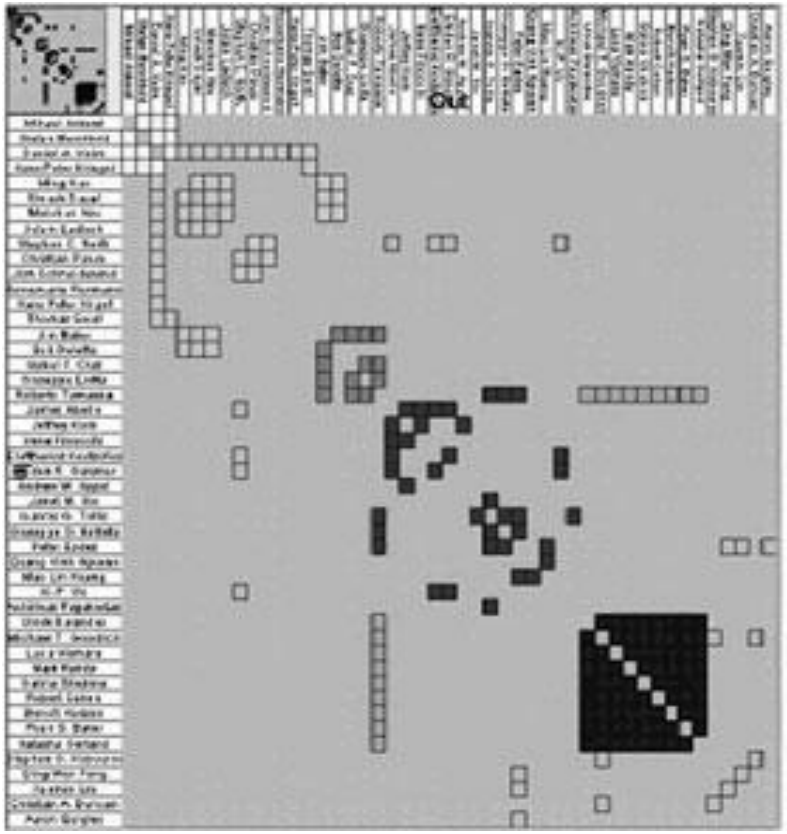
- Social network as graph with nodes and edges be represented as boolean matrix
- Boolean values in matrix can be replaced with valued attributes for more info about edges
- Minimizes occlusion problems caused by the node-edge diagram
- clusters and associations among the nodes can be better discovered
- For Complex relationship outperforms node-edge representations

Matrix Explorer

- MatrixExplorer - enhanced matrix-based representation
- Visualize social networks with a Dual-Representation - matrix and node-edge
- For social network with highly interlaced edges, help users quickly recognize the associations between nodes
- Reordered matrix can evidently help users find more clusters
- Not a replacement, but complement the shortcomings of a node-edge diagram

Matrix Explorer

Initial Order



TSP Order