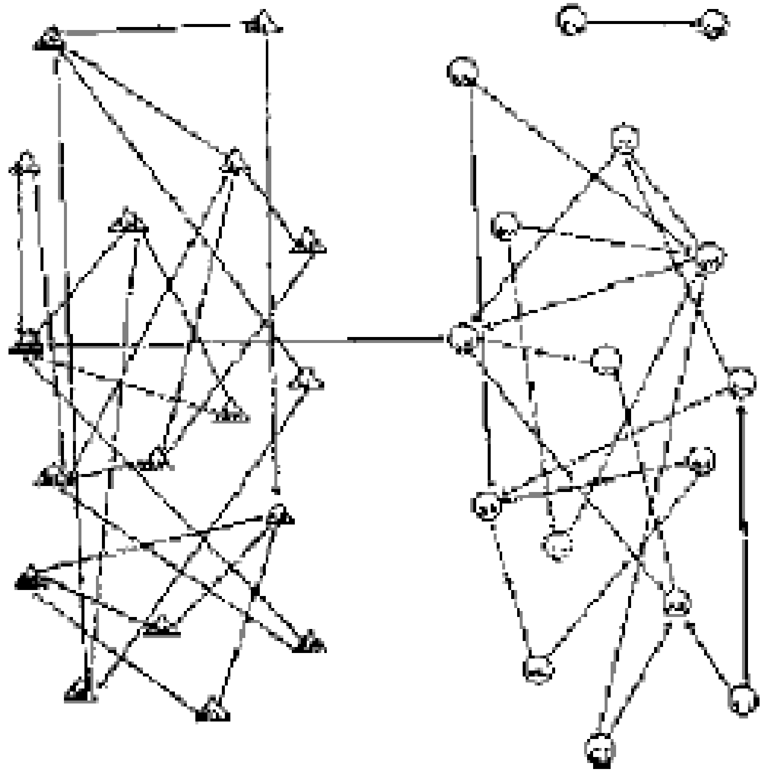
NODE LINK DIAGRAMS

Introduction

- Jacob Moreno was first & pioneer of social network visualization
- He used visualization to support his findings about social friendship in schools
- He used node-link diagrams to represent actors by nodes and connections by links
- Different shapes used - for males and females - arrows connect them (direction of friendship relation)



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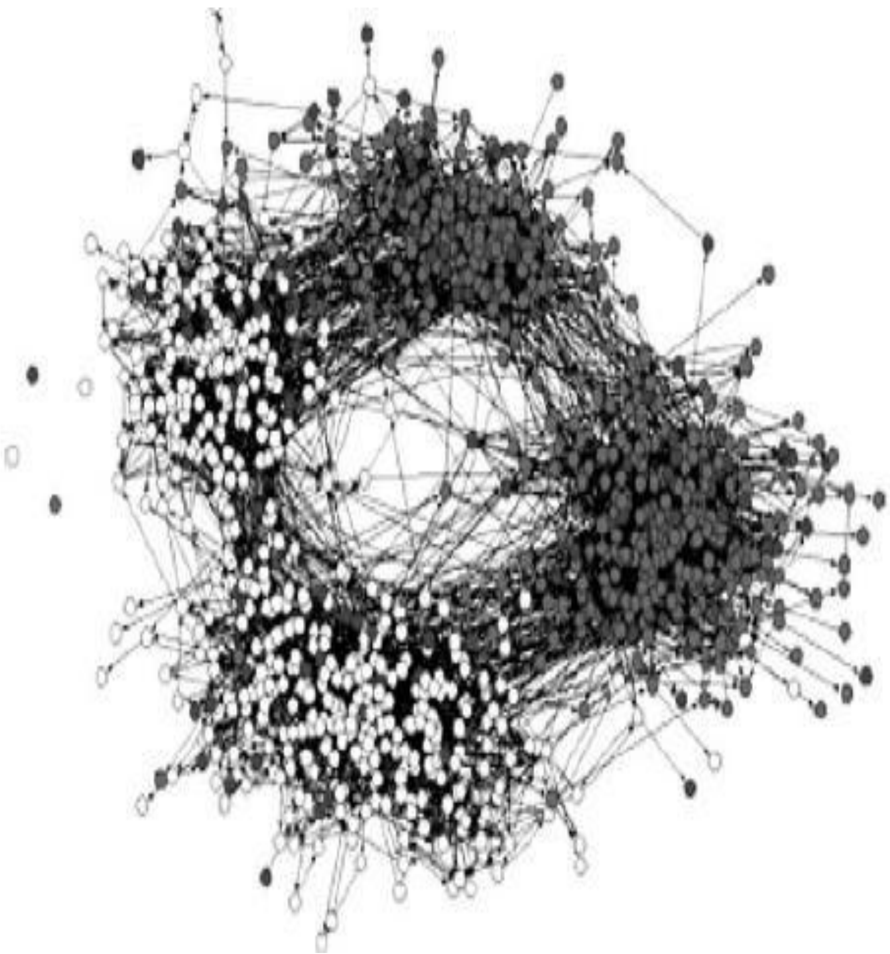
- visual representation can highlight central actors as in fig.
- Since 90, it's a Graph Drawing problem - generate algorithms to place nodes in the space based on certain criteria (Ex. Minimize cross links)
- More than 300 graph drawing algorithms to layout graphs in 2D space by researchers
- Difficult to identify a core set - create ideal layout algorithm.



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- Information visualization different from social visualization

- Last 2 figs shows best actors and social groups

- Different representations may help discover different insights in the data

- information visualization - not aim on ideal representation

- It advocates use of multiple representations for multiple perspectives on the data + interactions to quickly explore them

Scaling to Larger Networks

- Node-link diagrams with large no. of nodes becomes hairball of nodes
- Difficult to transform either automatically or manually into a readable representation
- Solutions:
- Reducing the quantity of information by filtering or aggregating data
- Representing a subset of the network and exploring it incrementally
- Providing more visual space to represent the graph
- Using an alternative representation

Reducing the Quantity of Information

- An obvious technique to reduce size of a graph (remove some of its vertices and edges)
- Two approaches exist to filter networks:
- Filtering out elements, preserving a representative sample
- Filtering data that is not of current interest to the analyst
- Challenging for social networks due to small-world networks properties
- Filtering links results in disconnecting network or losing power-law distribution of connections

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- Alternatively, hierarchical decomposition of graphs
- each level is coarsened version of the previous one
- It speed-up the layout computation - provides several zooming level
- But due to small-world property, coarsening locally dense graph still produces a locally dense graph in smaller size

Second Approach

- Filter nodes and edges according to value of a given measure
- Measure computed from:
- Structural properties of graph. Ex. filter by connected components
- Based on data properties Ex. filter data by year
- Ex. SocialAction - nodes and edges ranked on centrality or betweenness
- It controls sections of the network displayed also color and size

Different Approach

- To reduce quantity of information displayed - aggregate nodes and edges Cluster data using graph clustering techniques
- Then, to gain space, vertices of same cluster is aggregated into a single representative super-node
- Aggregating the network at multiple levels of details Ex. Ask-GraphView
- Aggregation results in loss of detailed information inside the super-node
- So data attributes of individual nodes is averaged
- Or other attributes is created (count of elements in the cluster, averages, min values, etc.)

Incremental Exploration

- Main challenge is to obtain a readable layout in a reasonable time
- Draw trees without crossings in linear time with the number of nodes exists
- Further possibilities is to draw networks as trees and “fix” them by adding additional links
- If no tree structure, the visual representations become less readable
- Solution is to show only a subset of the network + provide interaction to explore the remaining parts Ex. TreePlus
- Disadvantage of incremental exploration is the lack of overview
- Difficult to guide the analysis for users to explore whole network

Using More Visual Space

- Alternate approach to offer more display space minimizing number of link crossings
- Drawback of 3D representations is the occlusion
- Difficult for users to create a mental map of the whole network
- To solve these issues, provides multiple views to users
- Or offer navigation and interaction techniques to visualize network under multiple angles
- However these techniques disorient users, making visual exploration fruitless
- studies show that if 3D visualizations do not improve performances – sometime decreases for several tasks

Alternate Representations

- Treemaps - similar to Venn Diagrams where sub-trees are depicted with inclusion

- Treemaps + Links

- Bar charts and scatter plots – No visual overview of actual actors and connections – answering by query

- Adjacency Matrix Representation

Adjacency Matrix Representation

- Vertices represented in rows and columns – if connected marked at intersection
- node-link diagrams suffer from link crossings for large networks not in matrix representation
- Time to draw less, actors placed linearly
- 2 Factors need to be considered:
- Require reordering of rows and columns to get insights about data
- As it need quadratic space of number of nodes, effective navigation techniques needed to explore

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- Replace numerical values by visual indicators, reordering rows and columns - improves readability of tables and matrices
- Numerical table difficult to grasp higher-level organization of data
- So, transformed into graphical indicators - rows, columns manually reordered – can easily discover a number of insights
- Techniques to linearize graph, minimize bandwidth of a table are used to reorder adjacency matrices
- Techniques quality depends on data and task

Navigation

- Techniques exists to navigate in large spaces at different levels of details
- Bird’s eye views - miniature overviews of whole representation, users can move the position of their current view, faster navigation than standard scrollbars
- Fisheyes - allows visualizing multiple levels of details in a single view, acts as magnifying lenses increasing details on regions of interest
- Folding the space in 1D or 2D to provide both readable labels and context
- Techniques provide navigation in aggregated matrices