Visualization with Matrix or Node-Link

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Advantages of Matrices

- Low create time, readable, good to initiate an exploration.
- Do not suffer from node overlapping (good to read actors label)
- No link crossing each other (good for dense network)
- Highlight the lack of connections (as shows all possible pairs)
- Shows directedness of the connections

Advantages of Node-Link

- Familiar representation to a wide audience
- For small or sparse networks, node-link diagrams are more effective than matrices
- For compact representation, node-link diagrams are a better choice.
- Analysis for path-related tasks, node-link diagrams are more appropriate.

Matrix + Node-Link Diagrams

- Combines the advantages of both representations
- Goal is to support the visual exploration of social networks. Example: MatrixExplorer

MatrixExplorer

- It consists of 4 stages:

1. Initiate the exploration
2. Explore interactively and iteratively
3. Find a consensus in the data or validate an hypothesis
4. Present the findings

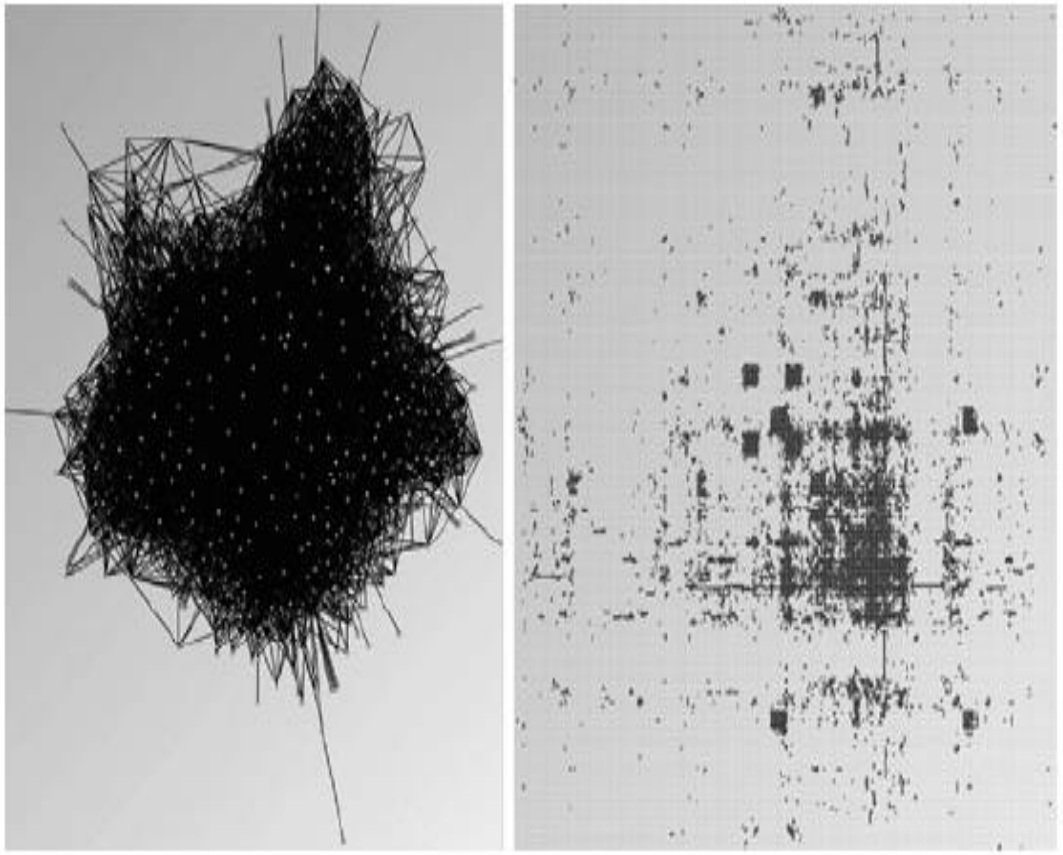
Initiate Exploration

- Matrices provide readable representation of a network (large), low rendering time – suitable to initiate the exploration

Example: Email exchange of more than 450 persons during a year

Inferences:

- Email exchanges between two persons are represented by a link or a cell filled with black in the matrix.
- Using traditional force-directed layout, makes it difficult to identify specific nodes or links
- Dense network represents everyone have been exchanging emails
- Few nodes on the periphery, indicating that a few persons did not communicate



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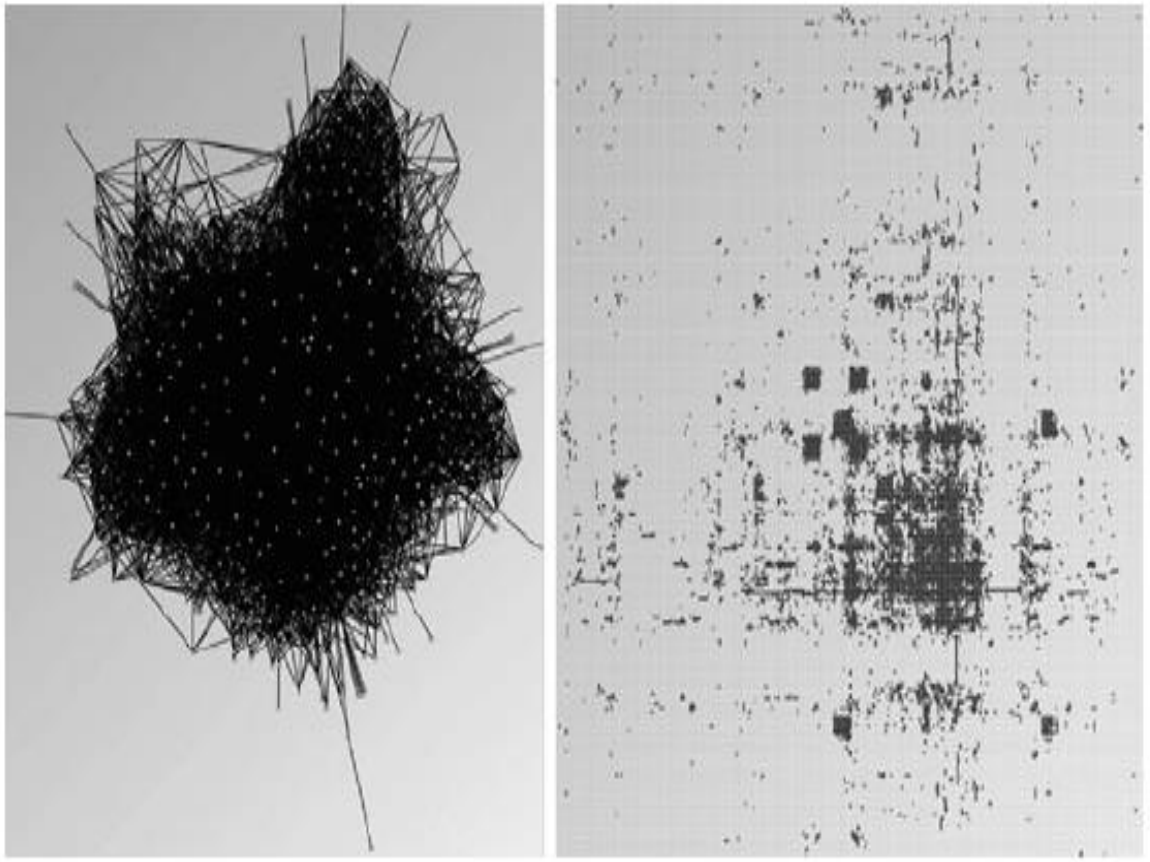
- Matrix representation conveys far more information
- Black dot represents a connection between a row and a column (i.e. an email exchangebetween two persons)
- The gray background shows the lack of connection
- Allows an analyst can quickly assess the network
- Majority of gray in the matrix showing that many actors did not exchange email with each other
- Clusters of black dots represents groups or research teams



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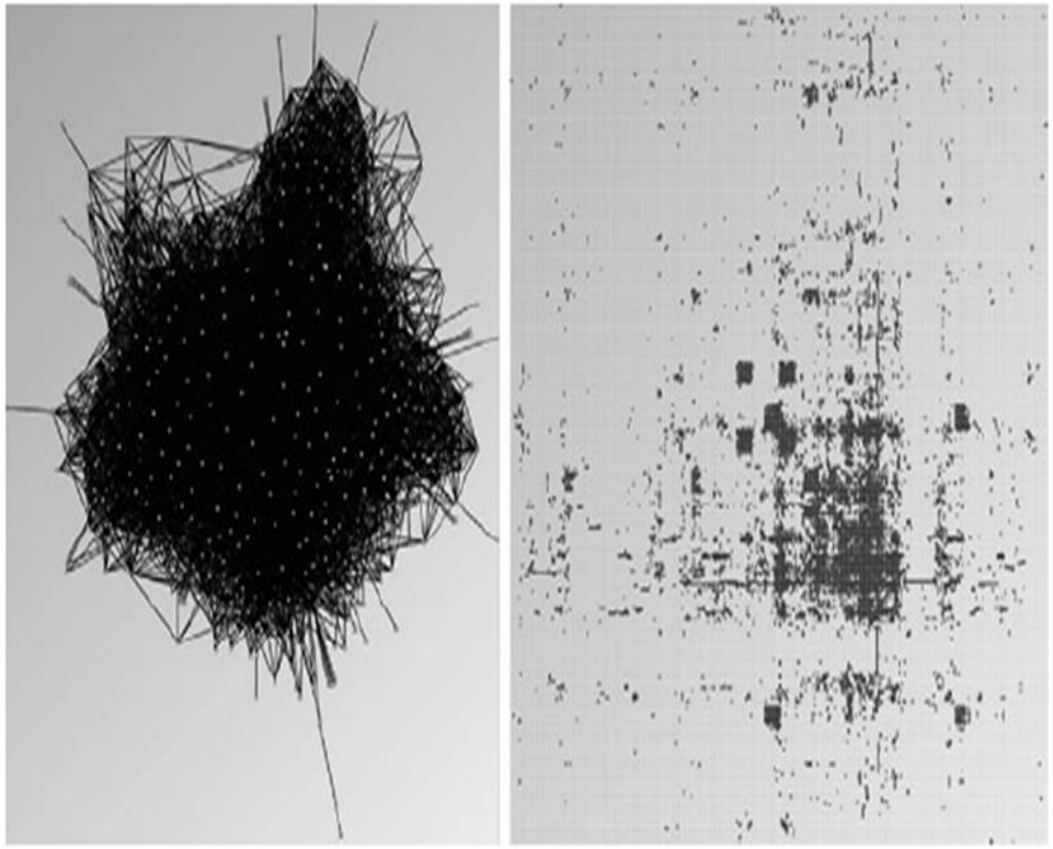
- Cross pattern: vertical and horizontal lines constituted of black dots- administrative service, dealing with travels of the whole institutions and thus, communicating with many persons in the network
- Shows power of matrices
- When correctly reordered, matrices highlight salient patterns of a network such as clusters or central actors
- Need expertise to decode and interpret these visual patterns



Explore Interactively

- Exploration process itself is iterative and requires the creation of multiple visualizations
- Interaction on these representations includes the configuration of the visualization
- Example: adjust its layout and its graphical attributes, the filtering, grouping, aggregation of some of its elements
- Both the matrix and node-link representations support the analysis of the network at different levels of details.
- Overview of the network to identify its main communities, the matrix is the best option
- More detailed analysis to identify actors bridging two communities node-link diagrams good

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- MatrixExplorer provides multiple views of the network and number of tools to interactively manipulate matrix and node-link representations
- Matrix and node-link representations are synchronized to ease the identification of visual patterns
- Selecting a row or column in the matrix highlights the corresponding node in the other representation.
- Visual variables such as size or color can be shared by both visualizations
- Use matrices for some tasks and node-link diagrams for other
- Selecting a visual pattern in the matrix and visualizing its equivalent in the node-link diagram makes easy understanding to less expert users

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- To interactively manipulate matrix and node-link representations set of tools:

1. Interactive specification of visual attributes.

- The user controls the mapping data-visual encoding by entering values in a text field or selecting a value in a list
- Visual attributes of nodes label, color, transparency or size etc

2. Interactive layout and reordering

- Users may directly move a node or a row/column in both representations to change its position or order

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3. *Automatic layout and reordering techniques*.

Algorithms to Automate layouts and reorderings to ease users computation time and quality

4. *Computer-assisted layoutand reordering techniques*:

To apply layout and reordering algorithms to specific subsets of the network

5. *Interactive filtering*.

Filtering actors or connections according to a selection or by selecting a specific value of a data attribute from a list using dynamic queries

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6. *Interactive clustering*.

- Groups of actors mark them and associate them to a visual attributed such as the color or shape of the nodes.

7. *Overview + Detail techniques to navigate in both representations*.

- To support navigation in large visual spaces, focus + detail techniques Bird’s eye view to nagivate and a fisheye lens to magnify regions of interest for details
- A Treemap to represent the macrostructure of the network
- A fast filtering mechanism to isolate each connected component of the network.

Find a Consensus in the Data

- Each visualization may lead to the discovery of different insights. While in many cases, these i
- Insights confirmed by searching them using different representations, layouts or order during the analysis
- Different techniques to reorder the matrix may lead to different cluster sets.
- To help analysts find a consensus and validate hypotheses, some support is needed.

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- MatrixExplorer allows analysts to find consensus in the data through simple interactions.
- Reordering the matrix several times, analysts can identify clusters appearing clearly in multiple orders as more valid.
- To mark the uncertainty of attribution of an actor to a given cluster
- Degree of membership of the element to a given cluster (less likely to belong to a cluster with a lighter color)
- Supports overlapping clusters and multiple sets of clusters: elements may belong to multiple clusters at the same time.

Present Findings

- Matrix representations may prove effective when exploring large networks
- Node-link diagrams are essential to communicate findings to a wide audience
- Many node-link diagrams may be created for presenting results with different filters and possibly different aggregations
- MatrixExplorer allows users to generate pictures while performing the exploration