ManyNets: An Interface for Multiple Network Analysis and Visualization

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ManyNets offers a powerful new approach that enables network analysts to work on multiple networks simultaneously. Several thousand networks can be presented as rows in a tabular visualization, and then inspected, sorted and filtereds in different ways. In a network table, each row is a network while the columns represent the featurs of those networks; it can be a network metic (e.g, node count) or a distribution of values throughout the whole network (e.g, distribution of degree of nodes). Cell visualizations and interactive column overviews allow analysts to assess the distribution of attributes within particular sets of networks. Details, such as traditional node-link diagrams, are available on demand. The node-link diagram can also show several networks merged into a single one.

ManyNets allows analysis of separate networks by loading them on a single table and then manipulating them as necessary. For example, we can load networks of Facebook students groups from different universities and compare these networks. Drawing these networks would take a long time, as some of them have more than a hundred thousand edges. The resulting pictures would also be difficult to interpret, and even more difficult to compare. But from ManyNets table we can easily compare the attributes of these netwroks.

We can also analyze parts of a single network by dividing it into smaller components according to neighborhood, motif, cluster, attribute values etc. For example, we can find 'user types' by looking at the local neighborhoods within social network by splitting it into all its ego-networks. Again, we can compare larger neighborhoods to one another by splitting the large network into its connected compoenets. MnyNets interface also provides flexible ways to split network according to a specific network feature, e.g, creation of time-sliced subnetworks to observe periodic trends.

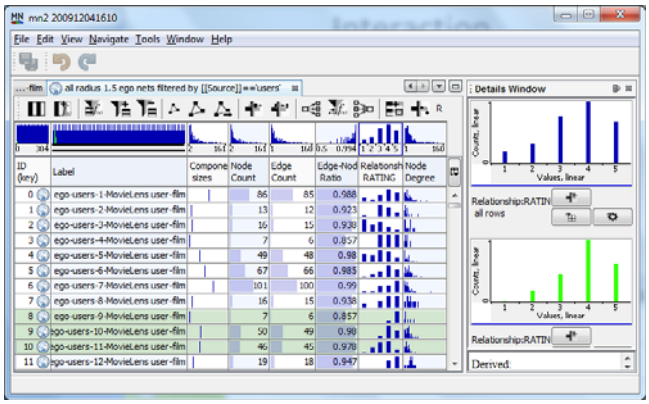

Figure 1: The MovieLens network split into user-film ego-networks, i.e. each row is a network with a user and the movies rated by him. Each user rates many films, with scores 1 to 5. The networks' size, node count, edge count etc. are shown in columns. The distribution of ratings and node degree appear as histograms. The histogram overview of the whole Rating column for all networks appears in the right side pane and the same for only the selected networks 8,9,10 is drawn just below it in green bars. The graph table of MovieLens, entity tables 'users' and 'films', relationship table 'user-film' are also shown in separate tabs.

Current network visualization tools such as NodeXL (node-link representation), and Zame (matrix representation) provide ways to visualize only a single network and show only the network attributes that contain a single value with limited user interactions. Especially the network generation task is not easy within the interface provided by them. Through ManyNets, entity-relationship schema can be used to load the tables and generate the networks. Its multi-level table manipulation system has entity and relationship tables in the lowest level. Entities are stand-alone, can be used as nodes where relationships relate two entities and are mapped to edges. The networks defined by the schema are presented as rows in the network table. Inside each network we have node and edge tables; nodes come from entities

and edges come from relationships. In ManyNets, we can mix multiple entities, relationships in a network resulting multi-modal network.

Useful visual analysis is only possible with proper user interactions. In ManyNets, columns can be removed, sorted and rearranged in the table. Moreover, we can add new columns from menu and via user-specified expression. Filtering rows from the table is also possible via selecting rows in table or even with user defined expression. The option to provide user defined expression is also available for filtering nodes and edges from networks. Details are provided on demand as tooltips and in side-pane as various types of overviews.

Tables often have many rows to fit on the screen and in such cases scrolling up and down is needed. Again, if the data within a column exhibits a certain trend, or if two columns are correlated, users might benefit from examining an overview of one or more columns. Our column overviews are interactive configurable visual overview of a whole column with provision to view in separate window. A network feature may consist of distribution of values, in this case each cell of the column contains a distribution, and we can represent the distribution in each cell by color coded heat map or by histogram. The overviews of such distribution columns can be represented by an aggregated histogram or stacked heat maps of all the cells. We can sort the heat map overview according to various distribution metrics that helps to find out similar patterns and outliers in the distributions. We can also perform cluster-based sorting of the distributions using complete-linkage agglomerative clustering, and then rearrange the resulting dendrogram using the optimal leaf ordering algorithm.

Another advanced feature of ManyNets is its ability to derive new relationships and generate new networks from them. Users can access and visualize the complete schema and define relationship resulting in new relationship table available to create new networks. Connections between two entities can be created if they share destination or they are reachable via a path within the network. As the provisions to create network from relationship and dividing existing network are integrated with this tool, analysts do not need to process the data from outside for these purposes and perform analysis using only ManyNets.

In conclusion ManyNets provides a way to look at many networks at once, even starting from a non-network dataset. It also facilitates to reveal patterns and outliers within network attributes with interactive exploratory search. It is designed in specifically for network analysts and helps them build and explore networks where they can split, filter, rank, visualize and synthesize many networks using this interface.

PAPERS

1. Sopan, A., Freire, M., Plaisant, C., Golbeck, J., Shneiderman, B. (April 2010) Distribution Column Overviews in Tabular Visualizations. *HCIL Tech Report* HCIL-2010-01. Under submission. (2010).
2. Freire, M., Plaisant, C., Shneiderman, B., Golbeck, J. ManyNets: An Interface for Multiple Network Analysis and Visualization. *Proc. of ACM CHI 2010*

Development page

Application download, datasets, manual

tangow.ii.uam.es/mn/

Academic page

Publications, demo videos

www.cs.umd.edu/projects/hcil/manynets/

Acknowledgements

- Partial support from Lockheed Martin
- Manuel Freire is supported by Fulbright Scholarship