# Comparative Analysis of Social Network Analysis and Visualisation Tools

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## ABSTRACT

Data Analysis and Visualization is very important for big organizations. When social network data grows rapidly, it becomes difficult to analyse and visualize the data and perform complex comparisons. Various Data Analysis and Visualization tools are used to overcome this problem. The research provides a comparative study on popular visualization tools -Gephi, Cytoscape, SocNetV and yEd that could be used in the analysis of large datasets. Comparison study is categorized based on their significance-basic functionalities, network types, graph layouts, input file formats, graph attributes. Researcher uses denotation to measure social network analysis and visualization tools based on attributes.

**Keywords:** Graph Mining, Social Network Analysis, Graph Attributes

## I. INTRODUCTION

Graphs become progressively essential in modeling complicated structures, such as images, biological networks, circuits, social networks, the Web, and XML documents. Social Network Analysis (SNA) studies relations between individual actors including the analysis of social structures, social position, role analysis, and many others. These relationship between nodes are presented as a network. [1]

There are various Social network analysis (SNA) software are available that includes two packages based on graphical user interfaces (GUIs) or packages made for programming / scripting. [2] GUI packages are generally easier to learn while programming tools are powerful and extensible. GUI packages have been well documented. Programming tools have been also well documented and used to analyze network.[3]

The features of SNA software are the calculation of network standards and statistics (eg, Density, Diameter, Betweenness, Centrality, Clustering, etc.), creating adjacency matrix, list edges, or edges, visualization and more.[4] Social Network Analysis Tools may include discovering the structure of social
network, finding different attributes of the network, visualizing whole social network and finding communities.[5]

## II. METHODS AND MATERIAL

Social network analysis and visualisation tools are used to analyse and visualise all nodes and edges from various social networks.

Researcher has selected four analysis tools for comparison- Gephi, Cytoscape, SocNetV and yEd. All these four software are freely available and can handle large size of graph. These tools are deeply studied in term of language implementations, features (access to plug-ins and library functions , calculating statistical measures like centrality, betweenness, the degree of nodes, the leading index, density, diameter and more), platform, input and output formats, volume of received data, download (free or not), open sources.

Gephi: It is basically used for visualize and explore all kinds of graph. It can run on Windows, MAC OS X and Linux or any operating system which support java 1,6. User interacts with the representation, manipulate the structures, shapes and colors to reveal hidden patterns. The goal is to help data analysts to make hypothesis, intuitively discover patterns, isolate structure singularities or faults during data sourcing. It is a complementary FOSS to traditional statistics, as visual thinking with interactive interfaces is now recognized to facilitate reasoning. [6]

SocNetV: Social Network Visualizer (SocNetV) is a cross-platform, user-friendly free software application for social network analysis and visualization. Social networks are displayed and analyzed as mathematical graphs, where vertices depict actors/agents and edges represent their relations. The application enables you to import social network field data, edit actors and links through point-and-click, analyse their social and graph properties, produce reports for these properties and embed visualization layouts to the network. [7]

Cytoscape : Cytoscape is an open source software platform which is used for visualizing complex networks and integrating with any type of data. Cytoscape was originally designed for biological research, now it is a general platform for complex network analysis and visualization. Cytoscape core distribution provides a basic set of features for data integration, analysis, and visualization. [8] yEd is a powerful desktop application that can be used to generate high quality of network very quickly and effectively. It provides large set of layout options through which we can visualize network in different ways. [9]

The research work concentrates on proposing a methodology for all standard attributes of Graph Mining that can be considered to derive accurate and precise outcomes of Social Network Analysis.

The researcher divides comparative study into five stages:.

Stage 1: Comparison based on Basic functionalities
Stage 2:Comparison based on Network Types
Stage 3: Comparison based Core Graph Attributes
Stage 4: Comparison based Graph Layouts

Dataset for Social Network Analysis and Visualisation

**Tools:**

The dataset used for the implementation is airlines. gml that was converted into airlines.graphml a common file format that
can be used in Gehhi, SocNetV, Cytoscape, and yEd file.
The graphical data has 235 nodes and 2594 edges.

## III. RESULTS AND DISCUSSION

**Stage 1: Comparison based on core functionalities**

Mostly all Social Network Analysis and visualization tools are freely available. All tools can run on Windows, Mac OS X, and Linux Operating Systems. Stage 1 shows the comparison based on core functionalities like nature, platform, supported no of edges, supported no of nodes, licence and language that are shown in table 3.1.

**Table 3.1** : Comparison based on Core Functionalities

| Basic Features | Social Network Analysis FOSSs | | | |
|---|---|---|---|---|
| | **Gephi** | **SocNet V** | **yEd** | **Cytoscope** |
| Nature | Stand alone Software | Stand alone Software | Cross Platform software | Stand alone Software |
| Platform | Any OS supporting Java 1.6 and OpenGL | Windows, Linux, Mac OS X | Windows, Linux, Mac OS X,Unix | Windows, Linux, Mac OS X |
| Supported no of nodes | 1,00,000 nodes | More then 1000 nodes | More than 1000 nodes | More then 1,00,000 nodes |
| Licence | CDDL + GNU GPL 3 | GNU General Public Licence 3 (GPL3) | Freeware | GNU LGPL |
| Language | JAVA 1.7+ | C++ and Qt | JAVA | JAVA |
| Supported no of edges | 1,00,000 edges | 10,000 edges | 10000 edges | 1,00,000 edges |

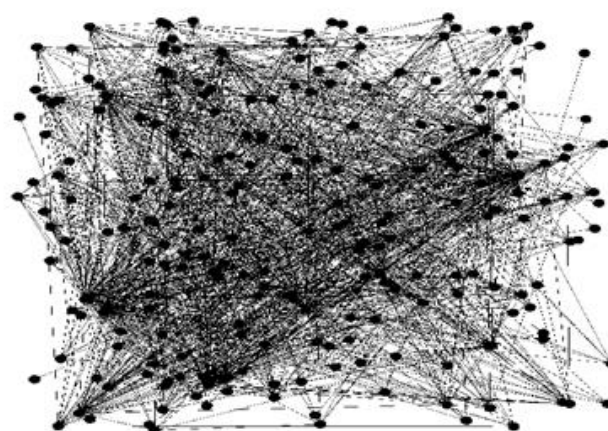Each tool gives different layout while loading airlines.graphml graph.



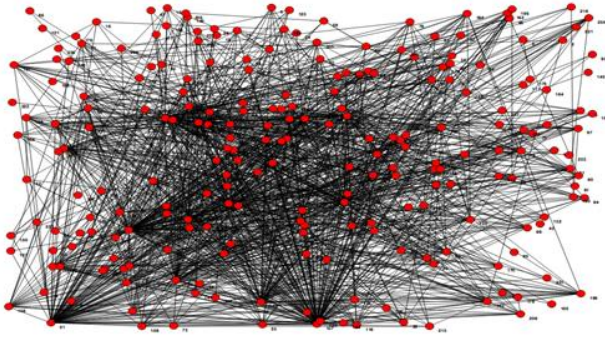**Figure 3.1** Loaded Graph in Gephi

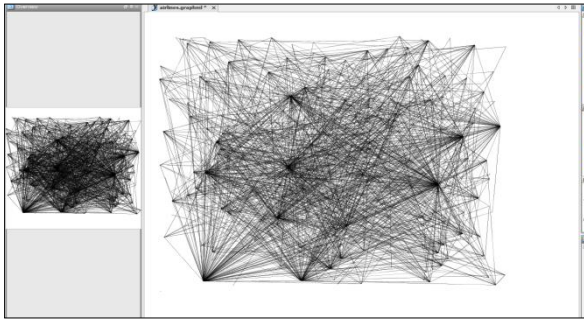**Figure 3.2** Loaded graph in SocNetV



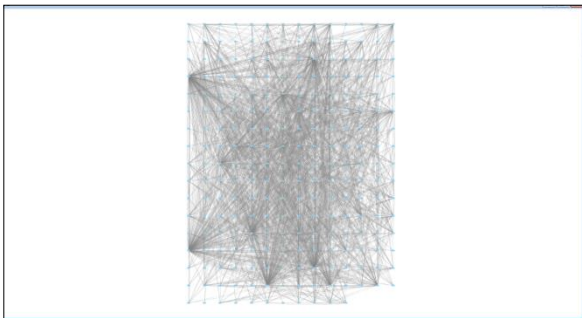**Figure 3.3** Loaded Graph in yEd



**Figure 3.4** Loaded Graph in Cytoscape

**Stage 2: Comparison based on Network Types**

In Social Network Analysis, there are four types of network types. For one mode or two mode network analysis there is Gephi, SocnetV and Cytoscapes. yEd can support only one mode network layouts as shown in Table 3.2.

**Table 3.2 : Comparison based on Network Types**

| Network Types | Social Network Analysis FOSSs | | | |
|---|---|---|---|---|
| | Gephi | Cytoscope | SocNetV | yEd |
| One Mode network Graph | YES | YES | YES | YES |
| Two Mode network Graph | YES | YES | YES | NO |
| Multi relational | NO | NO | NO | NO |

| | | | | |
|---|---|---|---|---|
| network Graph | | | | |
| Temporarily network Graph | NO | NO | NO | NO |

The totals count obtained in the Table.3.1 is based on the Supported Graph layouts and is obtained from study and implementation of User Interface features available in particular of Social Network Analysis Tools.

**Stage 3 : Comparison based Core Graph Attributes**
All Social Network Analysis and Visualisation tools supports various graph attributes represented in Table.3.3: Supported core Graph Features.
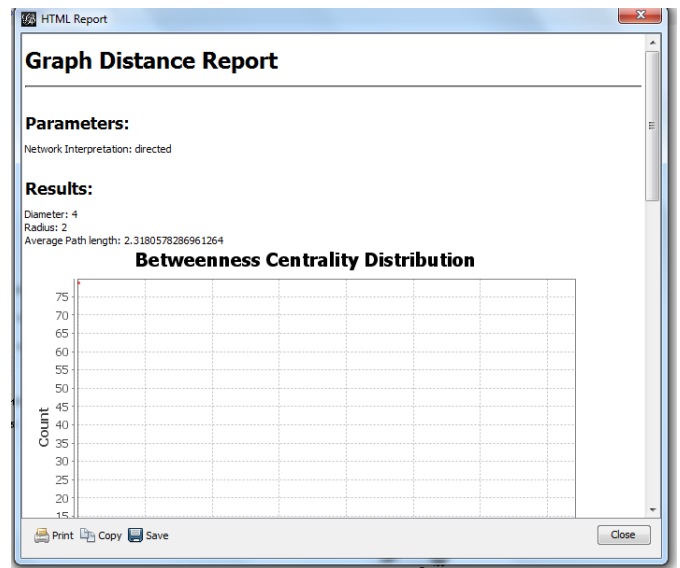


**Figure 3.5** Diameter measured in Gephi tool
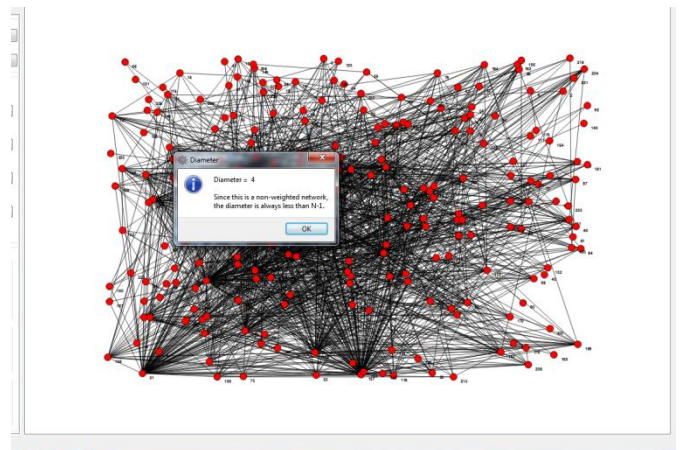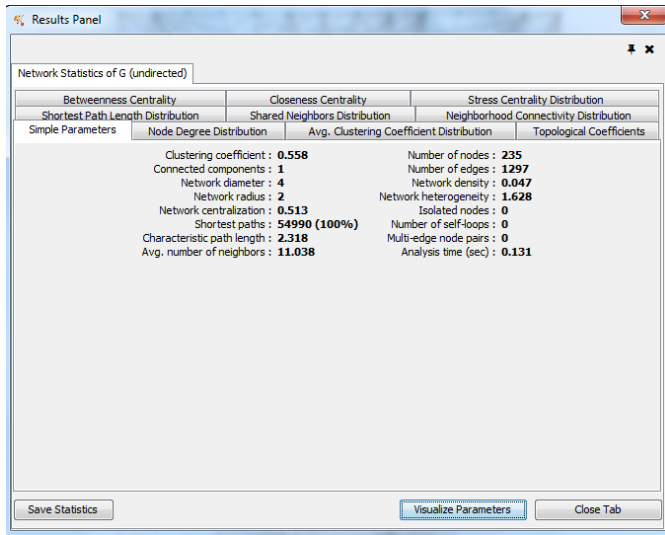
Diameter=4



**Figure 3.7** Diameter measured in SocNetV tool

Diameter=4

yEd tool does not provide diameter feature. The inferences drawn are denoted as YES for supported and NO for Not-Supported the particular feature.

**Table.3.3:** Supported Core Graph Attributes

| Graph Features | Social Network Analysis FOSSs | | | |
|---|---|---|---|---|
| | Gephi | Cytoscope | SocNetV | yEd |
| Centrality | YES | YES | YES | YES |
| Degree centrality | YES | YES | YES | NO |
| Closeness centrality | YES | YES | YES | YES |
| Betweeness centrality | YES | NO | YES | YES |
| Cliques | NO | NO | YES | NO |
| Page rank | YES | NO | YES | NO |
| Clustering coefficient | YES | YES | YES | NO |
| Radius | YES | YES | NO | NO |
| Avg. Path length | YES | YES | YES | NO |
| Modularity | YES | NO | NO | NO |
| Filtering | YES | NO | NO | NO |
| Density | YES | YES | NO | NO |
| Diameter | YES | YES | YES | NO |
| Trid census | NO | NO | YES | NO |

The totals count obtained in the Table.3.3 are based on the supported core graph features.

**Stage 4: Comparison based Graph Layouts**

In Social Network Analysis, different graph layouts are available. Each tool can support different types of layouts. From the table yEd provides various layout of graph as shown in Table 3.4.

**Table 3.4:** Comparison based Graph Layouts

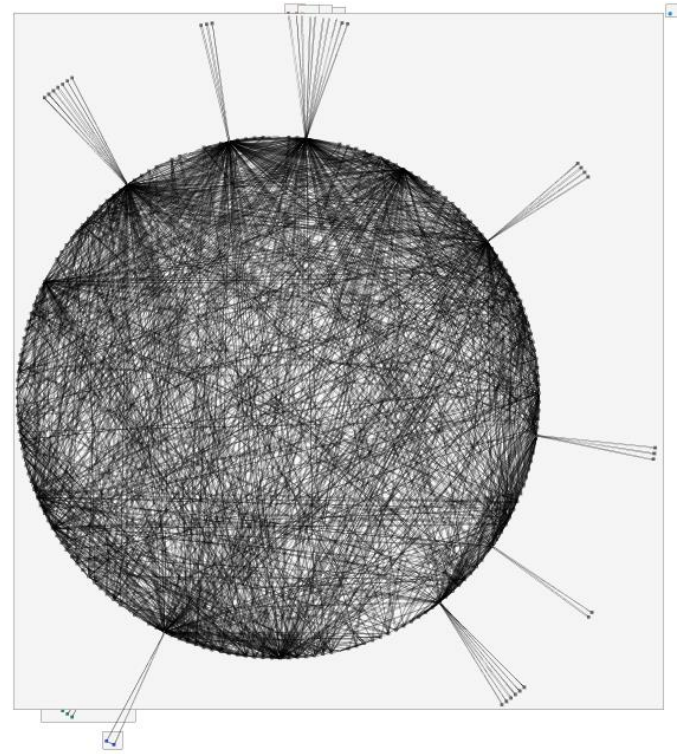| Graph Layouts | Social Network Analysis FOSSs | | | |
|---|---|---|---|---|
| | Gephi | Cytoscope | SocNetV | yEd |
| Circular Layout | YES | YES | YES | YES |
| Spectral Layout | NO | NO | NO | NO |
| Random Layout | NO | YES | NO | YES |
| Force Atlas Layout | YES | YES | YES | NO |
| Organic Layout | NO | YES | NO | YES |
| Orthogonal Layout | NO | YES | NO | YES |
| Tree Layout | NO | YES | NO | YES |
| Radial Layout | NO | NO | NO | YES |
| Flowchart Layout | NO | NO | NO | YES |
| Kamanda kawai Layout | NO | NO | YES | NO |
| Spring Layout | NO | YES | YES | NO |
| Fruchterman reingold Layout | YES | NO | YES | NO |
| Graphviz Layout | NO | NO | NO | NO |
| OpenOrd Layout | YES | NO | NO | NO |
| Yifanhu Layout | YES | NO | NO | NO |
| Hierarchical Layout | NO | YES | NO | YES |
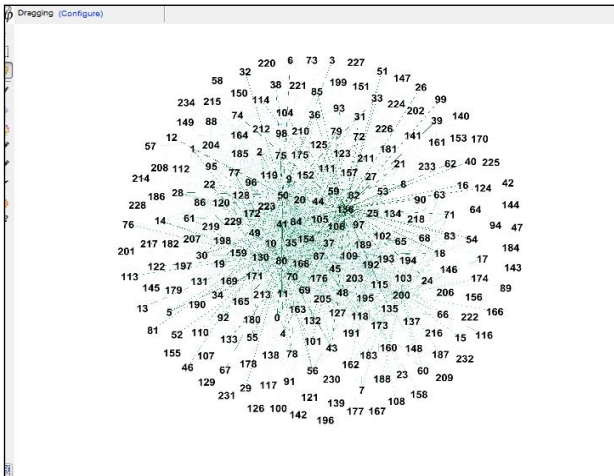
**Figure 3.8** Circular layout in Gephi tool



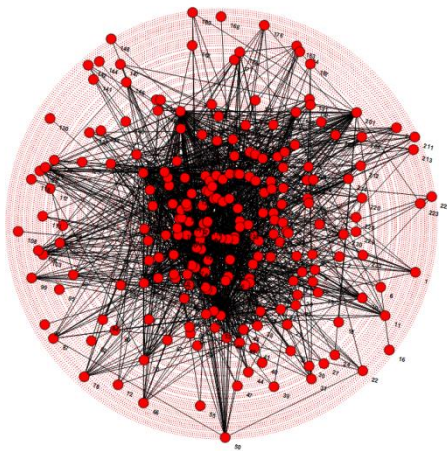**Figure 3.9** Circular layout in SovNetV tool
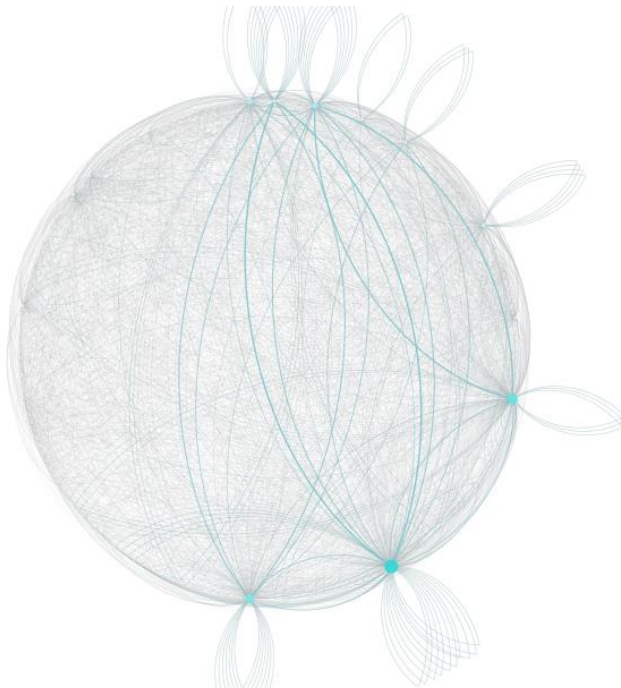


**Figure 3.10** Circular layout in Cytoscape tool



**Figure 3.11** Circular layout in yEd tool

The totals count obtained in the Table.3.4 is based on the Supported Graph layouts and is obtained from study and implementation of User Interface features available in particular tool.

For the result analysis, Researcher has used measuring denotation to derive the result outcomes for Comparative Analysis**.** The depth Analysis of Social Network Analysis and Visualization tools is based on a count measuring scale as shown in Table 3.5. The "B" denotation indicates that Social Nework Analysis tools provide Weak result whereas, "B+" denotation indicates that Social Network Analysis tools provide Average result. The third "A" denotation indicates that Social Network Analysis tools provide Good result while the fourth "A+" denotation indicates that the Social Network Analysis tools provide Strong result.

**Table 3.5**: Measuring Denotation

| Measuring Scale | Meaning |
|---|---|
| B | Weak |
| B+ | Average |
| A | Good |
| A+ | Strong |

<div align="center">**Table 3.**6 : Comparative Analysis</div>

| Social Network Analysis Tools | Gephi | SocNetV | Cytoscape | yEd |
|---|---|---|---|---|
| **Stage 1:Comparison based on Core Functionalities** | A+ | A | A | A |
| **Stage 2:Comparison based on Network Types** | B+ | B+ | B+ | B |
| **Stage 3:Comparison based on Core Graph Attributes** | A+ | A | A+ | B |
| **Stage 4:Comparison based on Graph Layouts** | A | A+ | A | A+ |

Above Table 3.6 displays Stage wise comparative analysis of different social network analysis and visualization tools. Gephi is in the Strong category to provide core functionalities because it can run on any Operating System and supports maximum number of nodes compare to other tools. Gephi and SocnetV provide maximum number of graph attributes. Gephi, SocNetV and Cytoscape provide Average denotation to support network types because they can support only one and two mode Network Types. SocNetV and yEd are Strong to support graph layouts. It supports maximum no of graph layouts.

## IV. CONCLUSION

It is very clear that all social network analysis and visualization tools are differing from each other in multiple aspects. All these tools give quantitative and qualitative analysis of social networks. These tools give interesting results for calculating network matrices and statistics. All these tools are stand alone software that are very useful for graph visualization and data format conversion. All these tools can run on Windows, Mac OS X and Linux operating system. Gephi and SocNetV tools can handle most of all input file formats. Gephi tool provides maximum features of graph that are centrality, degree centrality, closeness centrality, betweeness centrality, pagerank, density, and diameter. It is not possible to calculate cliques and triad census in Gephi tool. SocNetV tool gives excellent to calculate graph features. This tool analysis each and every vertex very deeply and display outcome in summarized

manner. Cytoscape tool provides less graph features compare to Gephi and SocNetV tools. Average execution time of Cytoscape tool is faster than others. The Graph Mining Analyst Professional can avail the optimized Graph Mining Attributes based Inference for Social Network Analysis and Visualization for the accurate and precise outcomes of Graph Mining Knowledge Discovery and to resolve any specific Graph Mining and Visualization research work.

## V. REFERENCES

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