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# Gephi: An Open Source Software for Exploring and Manipulating Networks

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The user interface (Figure 2) is structured into Workspaces, where separate work can be done, and a powerful plugin system is currently developed. Great attention has been taken to the extensibility of the software. An algorithm, filter or tool can be easily added to the program, with little programming experience. Sets of nodes or edges can be obtained manually or by using the filter system. Filters can select nodes or edges with thresholds, range and other properties. In practice filter boxes are chained, each box takes in input the output of the upper box. Thus, it is easy to divide a bi-partite network or to get the nodes that have an in-degree superior to 5 and the property "type" set to "1". Because the usefulness of a network analysis often comes from the data associated to nodes/edges, ordering and clustering can be processed according to these values. With

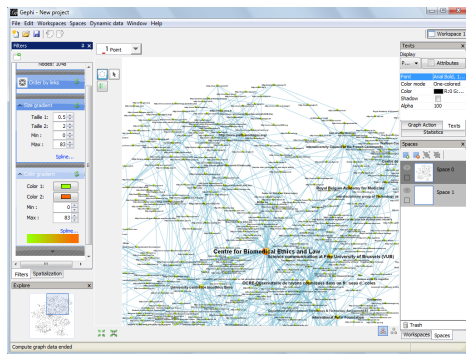


Figure 2: A screenshot of Gephi beta version 0.6

sets of nodes, graphical modules like *Size Gradient*, *Color Gradient* or *Color clusters* can then be applied to change the network design. Graphical modules take a set of nodes in input and modify the display parameters, like colors or size, to corroborate understanding of the network structure or content.

Though networks can be explored in an interactive way with the visualization module, it can also be exported as a SVG or PDF file. The vectorial files can then be shared or printed. A powerful SVG exporter named *Rich SVG Export* is included in Gephi. Many options are offered to users to set the design of nodes, edges and labels. Techniques are developed to increase networks clarity and readability. Special care is taken about fonts and labels. For instance, small labels can be drawn on edges to immediately see the neighbours of a node. The Figure 3 shows the brain network of the C. Elegans worm (Watts 1998) exported from Gephi.

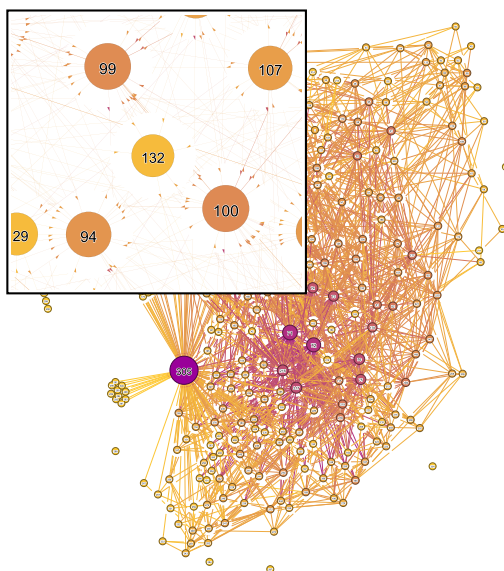


Figure 3: SVG File exported from Gephi

The current studies of network dynamics has brought some very interesting case study. Dynamic network visualization offer possibilities to understand structure transition

or content propagation (Moody 2005). Exploring dynamic networks in an easy and intuitive way has been incorporated in Gephi from the beginning. The architecture supports graphs whose structure or content varies over time, and propose a timeline component where a slice of the network can be retrieved. From the time range of the timeline slice, the system queries all nodes and edges that match and update the visualization module. Hence a dynamic network can be played as movie sequences.

The dynamic module can get network data from either a compatible graph file or from external data sources. When running, a data source can send network data to the dynamic controller at any time and immediately see the results on the visualization module. For instance a web-crawler can be connected to Gephi in order to see the network construction over time. The architecture is interoperable and data source can be created easily to communicate with existing software, third parties databases or web-services.

## Future work

Though the core of the software already exists, further work is required for the development of new features, especially filters, statistics and tools. A special focus is made on clustering and hierarchical networks. Improvements will be integrated to the data structure to support grouping and navigation within a network hierarchy. As for spatialization algorithms, a framework will be able to host various classification algorithms.

As we continue to receive feedbacks, we are looking forward to better adapt the user interface to users' need. Gephi has been successfully used for Internet link and semantic network case studies. It is also frequently used for SNA. An effort has been made to speed up the analysis process, from data import to map export. Gephi is developed toward supporting the whole process with only user interface manipulation. The development of dynamic features are also one of the top priorities.

## Availability

Gephi is available at <http://gephi.org>

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