

Web-Based Interactive Multi-Level Graph Visualization

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1 Overview

Graphs beyond a certain size can be difficult to comprehend on a visceral level. This demo is an online, interactive tool to solve this problem using multi-level graph layout. At the lowest level we have the graph itself. As we move up a level, nodes in the lower level are grouped (e.g. using techniques for community detection) to form supernodes.

Previous techniques [1] have used a multi-level graph approach to speed up layout generation, however our approach is to use a dynamic and interactive technique that allows the user to to navigate amongst all available levels of the graph. This technique reduces the number of active nodes on any given visualization, allowing the user to dedicate more attention to pertinent nodes. By utilizing a hybrid force-directed layout to determine the positions of nodes, we are able to render much larger graphs in the browser.

To render interactive graphs, we use the JavaScript framework Data-Driven Documents (*D3.js*¹). We introduce additional capabilities into this framework, specifically click interaction to expand or collapse nodes. We use the Python microframework *Flask*² to leverage a web based platform. This Python environment allows us access to *NetworkX*³, a Python package for working with networks. Additionally we leverage existing standards like the GML file format [2] to allow easy interoperability with other graph analysis software.

2 Features

Ease of Use As a result of leveraging a web-based platform there is very little lead time required to go from data set to visualization. By adhering to existing standards like the GML file format [2] we are able to service a large body of existing data sets with little pre-processing necessary. Additionally, as graph processing is done on the remote server, there is no concern about having to configure a local environment (outside of installing a browser) to handle graph visualization.

¹ <https://d3js.org/>

² <http://flask.pocoo.org/>

³ <https://networkx.github.io/>

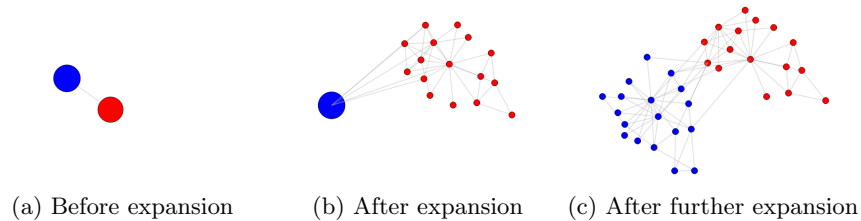


Fig. 1: Expanding a node cluster in Zachary’s Karate Club [5]

Interactivity Interactive tools allow for immediate feedback to the user—this decrease in response latency can enhance comprehension and provide handrails for learning how to use a tool. We also leverage common interaction tools: *zooming*, *dragging*, *expanding a node*, and *collapsing a group of nodes*. This interactive nature allows the user to maintain a much more accurate *mental map* [3] when transitioning between various levels of abstraction.

Navigation Traditional navigation techniques like *zooming* and *dragging* are implemented in the visualization tool. These techniques are well understood and intuitive, and again, can be leveraged to increase visceral comprehension of a graph. This tool allows a user to dynamically zoom to an appropriate level. This helps bring into focus nodes that the user is interested in exploring.

Collapse and Expand Nodes Perhaps the most useful aspect of this tool is allowing the user to collapse a group of similar nodes into one large structure or supernode, as shown in Fig. 1. We recursively apply modularity maximization [4] to partition the graph into various communities at different levels. We then use these detected communities to allow the user to reduce the number of active nodes at one time. By applying this technique recursively, we can generate multiple levels of abstraction, which, due to the interactive nature of this tool, the user can view at one time.

References

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