Introduction

Overview

This Add-On provides a layout algorithm to Vanted that implements the multi-level graph layout framework. The user can select a *merger*, a *placer* and a *layouter*, which will be applied as follows:

1. The *merger* iteratively coarsens the graph, producing a number of levels of decreasing resolution.
2. Starting from the most coarse level, each level is laid out using the given *layout* algorithm.
3. The resulting layout is then transferred to the level below using the *placer*.

Dependencies

The plugin requires Vanted 2.6.5, including the libraries it is based upon.

License

Like Vanted [1] , this software is licensed under *GNU General Public License, version 2* [2].

[1] https://github.com/LSI-UniKonstanz/vanted/blob/master/src/main/resources/license.txt

[2] https://www.gnu.org/licenses/old-licenses/gpl-2.0.html

Working with the Multilevel Framework

Background

The merger builds multiple graphs (*levels*) starting from the input graph. This process of creating representative graphs of decreasing size is known as *coarsening* or *merging*. During the merging process, several *inner nodes* are merged into one *merged node*. The merged node will be assigned coordinates to that it is centered between its inner nodes. The inner nodes can of course be merged nodes of lower coarsening levels.

Starting with the smallest graph (the most coarse level), the chosen layout algorithm is applied. Then, the placer uses the layout of the next (less coarse) level to provide an initial layout for the current layouting step. Traversing downwards through all the levels from the coarsest to the finest level, which is the original graph, results in adjusted initial layouts for all layouting steps.

Limitations

- The multilevel framework is meant to be used on undirected graphs. Directed graphs will be treated as if they are undirected.

- Only explicitly whitelisted layouting algorithms can be used.

Options

Random layout for topmost layer If checked, the topmost (most coarse) layer will be laid out randomly. If unchecked, the layout the layout of the topmost level is left unchanged. During construction of a level, merged nodes are placed centered relative to their inner nodes.

Selection of layouter, merger and placer Selecting a procedure the dropdown will display its parameter configuration below.

Mergers

Random Merger

The random merger selects edges at random and merges the nodes that they connect (the edges are "collapsed").

By default, it is not completely random, but prefers merging nodes with low weight (low number of nodes that they contain). It does this until a stop criterion (specified by the parameters described below) becomes true or no edges are left. The random merger stops at the first stop criterion that is hit.

Coarsening Factor Used to limit the number of edges that are actually merged. Other edges and their incident nodes are not touched and transferred without changes to the next level. For a graph with n nodes and m edges, the number of edges that will be coarsened is $c \cdot \min\{m, n\}$ where c is the selected coarsening factor. See below to see how edges are selected.

Minimum number of nodes per level The minimum number of nodes per level is a stop criterion for the random merger. If it finds that the number of nodes of the coarsening level that is currently being generated is less than or equal to this number, it will stop the coarsening process.

Maximum number of iterations The absolute-valued counterpart to the coarsening factor. It describes a maximum number of merge operations that will be done for one level.

Use merged-node weights If selected and the coarsening factor is less than 1, edges connecting merged nodes of low weight (i.e. containing few inner nodes) will be selected first for merging.

Consider edge weights If selected, edge weights of the given, bottom-most graph will be considered in the first coarsening step when selecting which edges to merge.

Weight attribute path This option determines the name of the edge weight attribute path that will be used if "consider edge weights" is enabled.

Solar Merger

The solar merger treats the graph and all the resulting smaller graphs as galaxies. The latter are a set of solar systems. Every node of the graph takes the role of a stellar body. There are three different types of bodies. Suns being the centers of their respective solar systems, planets which are nodes adjacent to their suns and moons which are neighbors of a planet but do not share edges to any sun.

In each coarsening step, every solar system is "collapsed" into its sun. In this step, all edges between nodes of the collapsed systems are kept as edges between the resulting nodes. To fully take advantage of the Solar Merger, you should choose a placer which uses the solar system structure to place the nodes (the "Solar Placer").

In order to find solar systems for a graph (level), first the graph has to be partitioned. This is done by determining a set of suns. Using a candidate set containing all nodes, a random node is marked as a sun. The sun and the nodes which are one and two edge-hops away are removed from the candidate set. This is done until there are no candidates left.

The set of suns is then used to set up solar systems. For each of the suns, its direct neighbors are marked as planets belonging to their sun. The remaining nodes, which are neither sun nor planet, are marked as moons with a single planet next to them as their planet. As a result all nodes of the Graph have a role (sun, planet or moon) and a corresponding solar system.

Finally, nodes and edges for the next level have to be created. For every solar system of the galaxy, the sun, all planets and moons are added as inner nodes to a merged node in the new graph. If one of the inner nodes had an edge to an inner node of another solar system an edge is created between the two new nodes.

This is done until one of the termination criteria is fulfilled.

Minimum number of nodes When the number of nodes of the graph/subgraph is lower than the given value, the Solar Merger stops.

Maximum level factor Limits how many times a new galaxy is created or, in other words, how many levels are generated. The size of the original graph divided by the maximum level factor is used as the maximum amount of levels.

Placers

Random Placer

The random placer places noes randomly within a given radius around the merged node.

Maximum place distance The radius within which the Random Placer places the nodes can be configured. If the layout algorithm you chose has a target edge length or a minimum edge length, a reasonable value for the radius option would be half of this length.

Solar Placer

The Solar Placer is the correspondent placer to the Solar Merger. It uses to the structure of solar systems to create promising initial layouts for the layouters. The placement is done by placing the sun for every solar system at position of the node representing the solar system in the smaller graph.

Planets which do not have neighbors in other solar systems and no moons with neighbors in other solar systems are placed randomly around the sun. Moons which do not have neighbors in other solar systems are placed randomly around their planets. Planets and moons which have neighbors in other solar systems are placed on a path between these solar systems' suns. The planets and moons on such a path are placed equidistantly on a line between these suns.

There are no options available.