Viewing graphs with *smyrna*

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Contents

1 Introduction

smyrna is an application for viewing graphs. It allows the user to open a window on a graph; navigate around the graph using pan and zoom; and select nodes and edges with the mouse. The GUI provides various simple mechanisms for changing the view of the graph and querying information about nodes and edges. In addition, *smyrna* allows the user to perform sophisticated querying and manipulation of graphs.

Although it works with graphs of any size, *smyrna* was designed to handle large graphs, on the order of 100,000 nodes and edges. It uses the OpenGL library which allows it to take advantage of modern video cards' graphics rendering features.

1.1 File Format

Currently, *smyrna* supports only the Graphviz *DOT* language. Please refer to

`http://www.graphviz.org/Documentation.php`

to get more information about the *DOT* language of Graphviz and the related attributes.

smyrna assumes the input graph has position information for all nodes. This is supplied by the `pos` attribute, whose format is two or three numbers separated by comma. Thus, for a node `start`, one might have

```
start [pos="23.5,288"]
```

If a graph is laid out using one of the Graphviz graph drawing programs, the position information is attached in this manner. For example, running the command

```
sfdp -o outgraph.gv ingraph.gv
```

will lay out the graph described in `ingraph.gv` and create the file `outgraph.gv`, which can be used as input to *smyrna*.

All *smyrna* settings are stored as graph attributes. For example, you can change the background color by setting the `bgcolor` attribute of the graph. Or the size of a node can be altered by changing its `size` attribute. These attributes can be modified through the *smyrna* GUI, using the built-in scripting (cf. 2.6), or by simply changing the graph file itself.

Normally in *smyrna*, nodes are represented by filled disks, which can vary in size and color. For smaller graphs, *smyrna* can render the more complex shapes and styles available in Graphviz. This requires the nodes and edges in the graph to have the necessary *xdot* attributes to describe the rendering. This can be achieved by running the Graphviz layout with the `-Txdot` flag, e.g.

```
sfdp -Txdot -o outgraph.gv ingraph.gv
```

For more information about *xdot* attributes and their formats, see

`http://www.graphviz.org/doc/info/output.html#d:xdot`

1.2 Visualization Modes

Smyrna has three display modes: 2D, 3D and topological fisheye. In 2D mode, the graph is displayed in the plane. Navigation is limited to panning and zooming. Any third coordinate in a node's `pos` attribute is ignored. In 3D mode, the graph is displayed using 3D graphics, allowing the user to rotate about the graph in addition to panning and zooming. Any node whose `pos` attribute does not have a third coordinate will be placed in the xy plane.

The topological fisheye mode [GKN05] presents a distorted, fisheye view of the graph, in which the areas of the graph near to one or more focus nodes are shown accurately, while the areas of the graph away from the foci become more "compressed" the further they are from the foci. For large graphs, this allows the user to see areas of interest clearly and in detail, while eliding detail away from the foci. Unlike ordinary fisheye techniques, in which the distortion is done geometrically, with remote nodes being drawn on top of each other, topological fisheye is a specialized type of semantic zoom in which remote nodes are combined into meta-nodes with induced edges, thereby maintaining the graph's topology in a coarsened form.

1.3 Querying, Filtering and Modifying Graphs

Beyond the simple viewing and navigating around a graph, *smyrna* also provides machinery for querying properties of the graph, modifying the graph and creating new graphs. The main engine for this is *gvpr*, a scripting language specifically designed to edit graphs. By using *gvpr*, you can do almost anything related to graphs, from counting the number of nodes with an attribute matching a given regular expression to fairly complex graph algorithms.

One can use *gvpr* to read and write files. In particular, *gvpr* scripts can write to `stdout`. This is implemented in *smyrna* but a console window, which is part of the *gvpr* control tab (Section 3.1.6).

When *gvpr* changes the structure or attributes of the active graph, these changes are reflected in *smyrna*. Conversely, nodes and edges that are selected have an attribute `selected=1`, which *gvpr* can use to provide actions on selected nodes and edges.

The use of *gvpr* is discussed in more detail in Section 2.6.

2 Using *smyrna*

One starts *smyrna* as with any program, either using a command interpreter to execute it or double-clicking on its icon. From the command line, it accepts a single argument giving the file name of a graph to be viewed.

This will open a main window for *smyrna* similar to that shown in Figure 1. The window has a fairly typical layout. There is a menu bar across the top, with some additional widgets on the right side of it. There is a control bar of buttons down the left side. The remainder of the window is the display area.

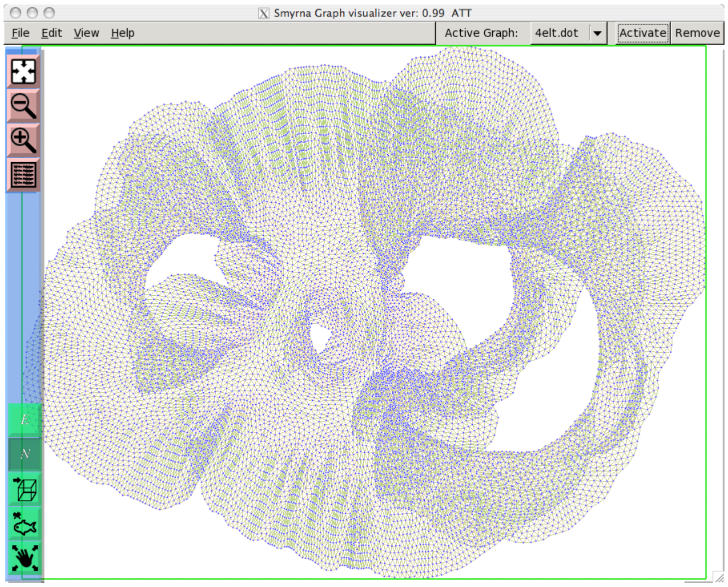


Figure 1: Typical *smyrna* view.

2.1 Opening a graph

If no file name is given on the command line, one can use `File->Open` to open a graph file. This can also be used read in additional graphs. When a new graph is read in, it is made the *active* graph, and the previous graph is added to the list of open graphs. One can make an open graph the new active graph by using the `Active Graph` menu at the top right of the main window, picking the desired graph, and then clicking on the `Activate` button.

Being able to switch back and forth between open graphs can be useful when analyzing graphs. However, due to resource consumption, one should avoid having too many open graphs. You can close a graph the same way that you activate it, except clicking on the `Remove` button rather than `Activate`.

2.2 Navigation

To zoom in and out on a graph, you use the scroll wheel or ball on the mouse. Or you can use the plus and minus magnifying glasses 🔍 🔍 on the left-hand icon bar.

To pan, click and hold down the left mouse button, and move the mouse. Releasing the mouse stops the panning.

Sometimes during navigation, you may find yourself in some obscure corner of the graph, or you've lost the graph entirely. By clicking on the top button ⊞ on the left icon bar, the view is reset so that the graph is centered in the window, and just large enough to fill it.

2.3 Selection

Smyrna has a notion of selected nodes and edges. To pick a single node or edge, right click on it. The color will change to indicate the selection; in addition, an attribute of the object may be displayed. You can use the Labels tab (Section 3.1.2) to specify which attribute you wish to see. If right clicked a second time, the object is unselected. Multiple objects can be selected.

One can also select multiple items by holding down the right mouse button and sweeping out a region. One can do this multiple times; the selected set is the union of all selections. What is selected is determined by the E and N buttons on the control bar, which activate the selection of edges and nodes respectively. Initially, only nodes can be selected.

The button ✗ at the bottom of the control bar can be used to unselect everything.

Choosing `Edit->Node List` opens the Node List widget (Section 3.2), which provides a text view of the selected nodes. It also provides the opportunity to save the selected nodes as a subgraph.

2.4 3D in *smyrna*

To move from a 2D to a 3D view, click the button ⊞ found in the control bar. Pan and zoom are achieved the same way they are in 2D. For rotation in 3D, hold down the left shift key, then click and hold down the left mouse button, and move the mouse. Returning back to 2D is done by clicking the control bar button ☐.

2.5 Graphical Node and Edge Attributes

To display more information about the graph, especially attributes that may be associated with nodes or edges, one can use various display attributes. The principal such attribute is color, stored as the `color` attribute in a node or edge. The attribute can be set already when the graph is read in, or it can be attached using the Attribute tab or the Script tab of Settings widget. If the color is not explicitly set, *smyrna* provides default values which can be set using the General tab of the Settings widget.

For cluttered drawings, it can sometimes help to play down parts of the graph. *smyrna* allows you turn off the drawing of either nodes are edges. There are check boxes for this also on the General tab. You can also reach a middle ground by having the edges or nodes drawn, but making them more transparent. To do this, one uses the Node Alpha and Edge Alpha sliders on the Graph tab.

The Graph tab also provides a Node Size slider. With this, you can uniformly increase or decrease the size of the nodes. If Node Shape is set to Spherical, you can set the size attribute of nodes to get a variation in node sizes. The attribute is used as a scale factor, so a size less than 1 will cause a node to shrink relative to other nodes while a size greater than 1 will enlarge the node.

For large graphs, lack of screen space means you usually want to see nodes drawn as small disks. This holds if Node Shape is set to either OpenGL dots or Spherical. The former is quicker to draw, but at present does not allow varying sizes among nodes. (The Custom shape is not implemented.) For smaller graphs with xdot attributes attached, *smyrna* will use the xdot information to draw the nodes and edges.

2.5.1 Defining and setting attributes

Attributes can be defined and set in *smyrna* using either the Attributes tab or *gvpr* via the Script tab. For setting atttributes, the former works on the set of selected nodes.

2.6 General Graph Manipulation

There are controls in *smyrna* for the most common operations such as navigation, selection by mouse and simple attribute queries. For more complex selection criteria, and general analysis and manipulation of graphs, *smyrna* is integrated with the *gvpr* graph processor. The main interface to *gvpr* is provided by the Script tab (Section 3.1.6), though *smyrna* also uses *gvpr* for various internal operations.

To use *gvpr*, you write a script in the *gvpr* language, which is then applied against an input graph. With the language, you can specify operations to be performed when the graph is first scanned; operations to be performed when each node or edge is visited; and operations to be performed after all node and edge processing has been done. Node and edge statements can have a boolean guard; with this, the action is only performed if the guard is true. As a simple example, the script

```
N[color=="blue"]{selected="1"}
```

causes *gvpr* to mark all blue nodes as selected.

Though *gvpr* is primarily designed for working with graphs, it incorporates the C language expression model, and provides many general-purpose C-like functions such as `printf` and file I/O, string manipulation functions, and associative arrays. A more complete discussion of the use of *gvpr* is outside of the scope of this document. The reader is refered to the *gvpr* man page for further information.

2.7 Topological Fisheye Views

3 *smyrna* Controls

In this section, we describe the various controls making up the *smyrna* interface. Figure 2 shows an example of the main *smyrna* display.

Across the top of the main window, there is a fairly standard menu bar. The `File` pull-down menus offers the choices **Open**, **Save**, **Save As** and **Quit**. These should be self-explanatory. The `View` menu allows you to make the console window a subwindow of the main *smyrna* window. The `View` menu also lets you open the Node List widget, which gives information about the currently selected nodes. This is considered in detail in Section 3.2. The `Help` menu provides access to information about using *smyrna* **but at present does nothing**.

The `Edit` menu consists of two items: **Smyrna Settings** and **Attributes**. The first activates the *smyrna* Settings Widget described in Section 3.1. This widget provides access to the parameters controlling *smyrna*'s behavior, as well as providing some high-level manipulation of the graph. The second provides a short-hand access to the Attributes tab (Section 3.1.7) of the Settings Widget.

On the right of the menu bar are controls for handling the loaded graphs. The currently active graph is shown. The names of all available graphs are provided in the associated pull-down menu. To switch between graphs, the user can pick another graph from the menu, then click on the `Activate` button. Alternatively, clicking on the `Remove` button closes the graph. **This doesn't appear to work.**

The top buttons along the left of the main window serve as simple controls for certain common actions.

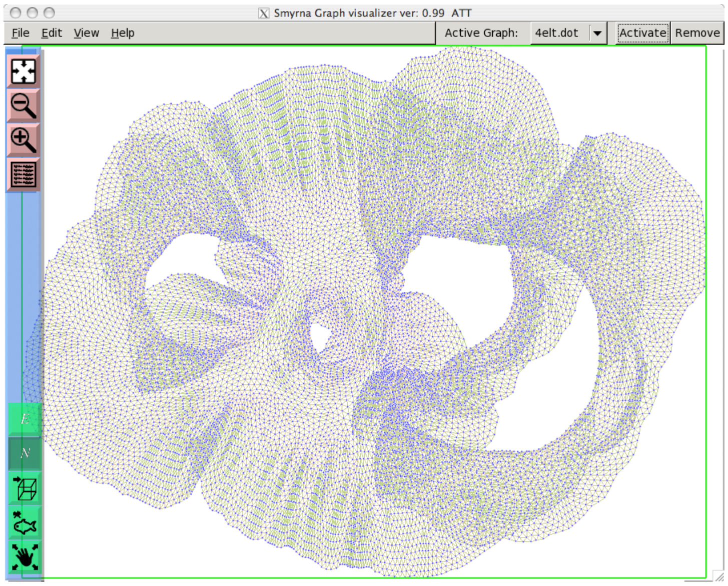


Figure 2: Typical *smyrna* view.

⊡ The top button is used to re-center the display.

🔍 🔍 The next two buttons allow you to zoom in and out.

▤ The fourth top button is yet another shortcut for opening the Attributes tab (Section 3.1.7) in the Setting widget.

The bottom buttons are used to toggle between states in *smyrna*.

E N The top two, E and N, determine whether edges and nodes are selected when doing an area selection. Programmatic selection or single selection by mouse still works even if these are unset.

☐ ⧄ The buttons toggle between 2D and 3D display modes. If the `pos` attributes of the nodes has only two coordinates, the z value is taken to be 0, and the graph appears in the XY plane.

🐟 🐟 The fish buttons toggle between the normal and topological fisheye views (Section 2.7).

✋ The last button unselects all selected objects.

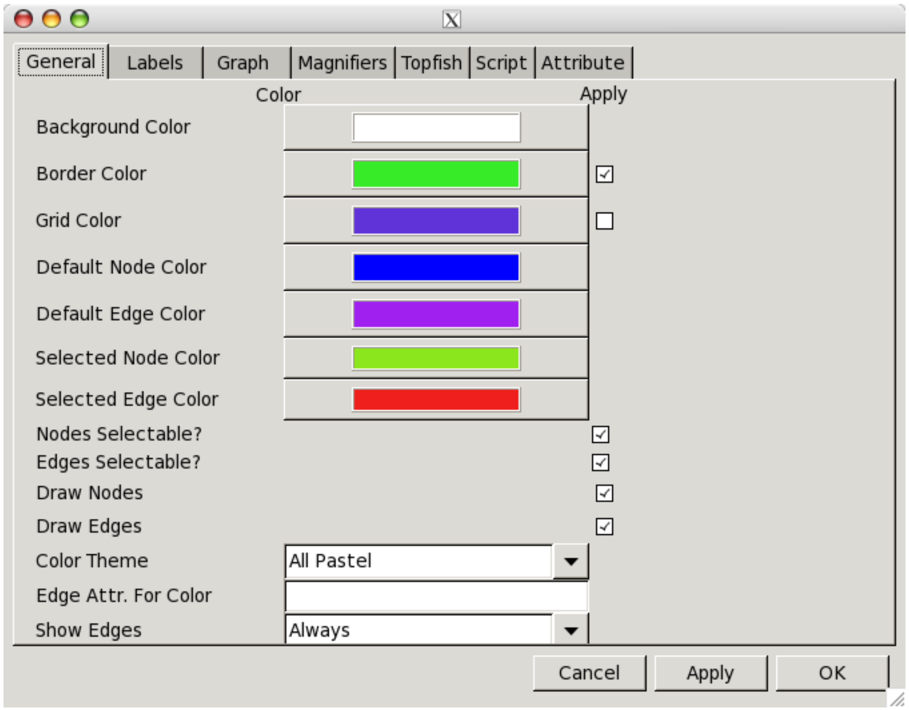
3.1 *smyrna* Settings Widget

This is the main control panel for controlling the display parameters in *smyrna*. It also provides two tabs for interacting with the graph: a high-level interface for dealing with graph attributes, and a general-purpose interface for applying *gvpr* on the graph. We discuss each tab individually in the following subsections.

Note that is necessary to click on the `Apply` button to cause the changes to take effect.

3.1.1 General Settings

The General Settings tab is shown in Figure 3. It provides control control over the default color schemes, and whether or not nodes and edges are drawn or can be selected. Clicking on one of the colors brings up a color selection widget that allows you to modify the color.



	Color	Apply
Background Color	⬜	
Border Color	🟩	☑
Grid Color	🟪	☐
Default Node Color	🟦	
Default Edge Color	🟪	
Selected Node Color	🟩	
Selected Edge Color	🟥	
Nodes Selectable?		☑
Edges Selectable?		☑
Draw Nodes		☑
Draw Edges		☑
Color Theme	All Pastel	
Edge Attr. For Color		
Show Edges	Always	

Figure 3: The General Settings tab.

Background Color Specifies the background color of the window.

Border Color Specifies the border color. If enabled, *smyrna* draws a rectangle about the graph to indicate its limits. This attribute specifies what color is used.

Grid Color specifies the color of grid points. If enabled, *smyrna* draws an array of grid points behind the graph.

Default Node Color gives the color used to draw nodes, unless specified explicitly in the input graph.

Default Edge Color gives the color used to draw edges, unless specified explicitly in the input graph or a color theme is selected.

Selected Node Color specifies the color used for selected nodes.

Selected Edge Color specifies the color used for selected edges.

This tab also provides check boxes to enable or disable various properties. These can be used to turn off the drawing of nodes, edges, the border or the grid. In addition, the ability to select nodes or edges using the GUI can be disabled.

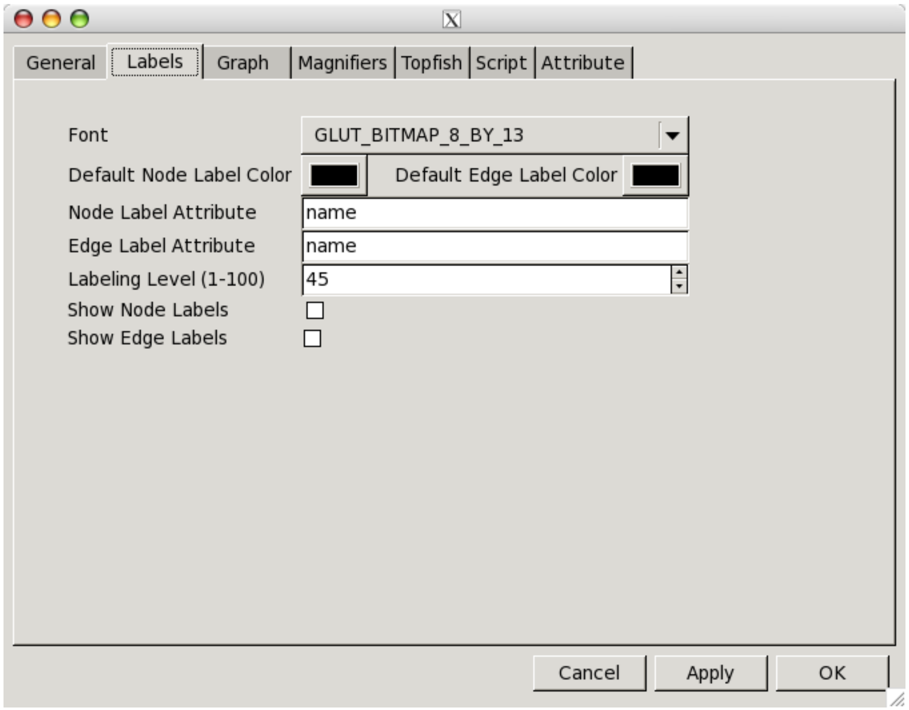
smyrna provides a collection of color themes which can be selected using the `Color Theme` menu. This specifies a color theme used to color edges with no color attribute. Edge color calculations are based on an edge's *len* attribute. A different edge attribute can be specified using the `Edge Attr. for Color` text box.

The `Show Edges` menu can be used to determine when edges are drawn. Normally, an edge is drawn if any part of it appears within the view windows. Sometimes, for clarity or efficiency, it is better to only draw those edges with at least one node with the view.

3.1.2 Labels

The Labels tab is shown in Figure 4. This tab provides control over labels used in *smyrna*. The `Font` menu can be used to set the face and standard size of the OpenGL font used to display text labels. The `Default Node Label Color` and `Default Edge Label Color` items can be used to specify which colors are used for node and edge labels, respectively.

The user can tailor what attribute is used as the label for nodes and edges. This is done via the `Node Label Attribute` and `Edge Label Attribute` text boxes. For example, a graph representing Internet communication may benefit from using a node attribute such as *IPaddress* or *hostname*. Note that, by default,



Font	GLUT_BITMAP_8_BY_13
Default Node Label Color	■
Default Edge Label Color	■
Node Label Attribute	name
Edge Label Attribute	name
Labeling Level (1-100)	45
Show Node Labels	☐
Show Edge Labels	☐

Figure 4: The Labels tab.

the label comes from the pseudo-attribute *name*. For nodes, this is the name of the node; for edges, the name is constructed from the names of its head and tail nodes.

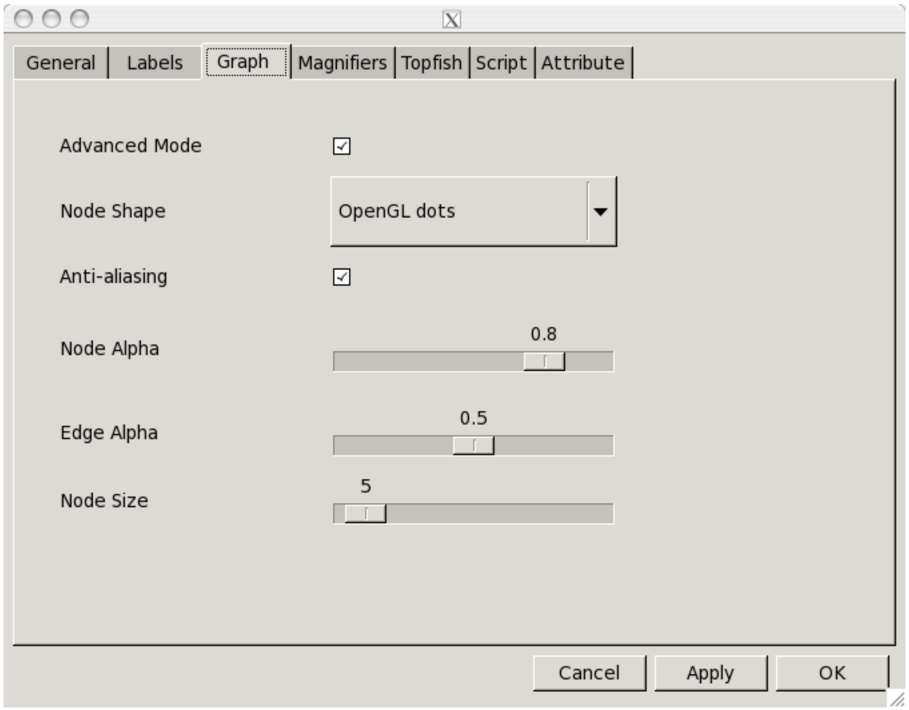
Labels are shown when an object is selected. In addition, if the Show Node Labels box is checked, labels are displayed for all nodes whenever one zooms in close enough. Close enough is determined by the Labeling Level widget. The smaller the number, the sooner labels appear as you zoom in.

3.1.3 Graph

The Graph tab is shown in Figure 5. With this tab, the user can affect more technical aspects of the graph view. The `Node Shape` menu allows the user to specify how nodes are drawn.

OpenGL dots Nodes are drawn as filled circles as efficiently as possible. All nodes will have the same size.

Spherical Nodes are drawn using OpenGL spheres. The advantage over OpenGL



Advanced Mode ☑
Node Shape OpenGL dots
Anti-aliasing ☑
Node Alpha 0.8
Edge Alpha 0.5
Node Size 5

Figure 5: The Graph tab.

dots is that each node can have its own size specified by the size attribute. The disadvantage is that it is not as efficient.

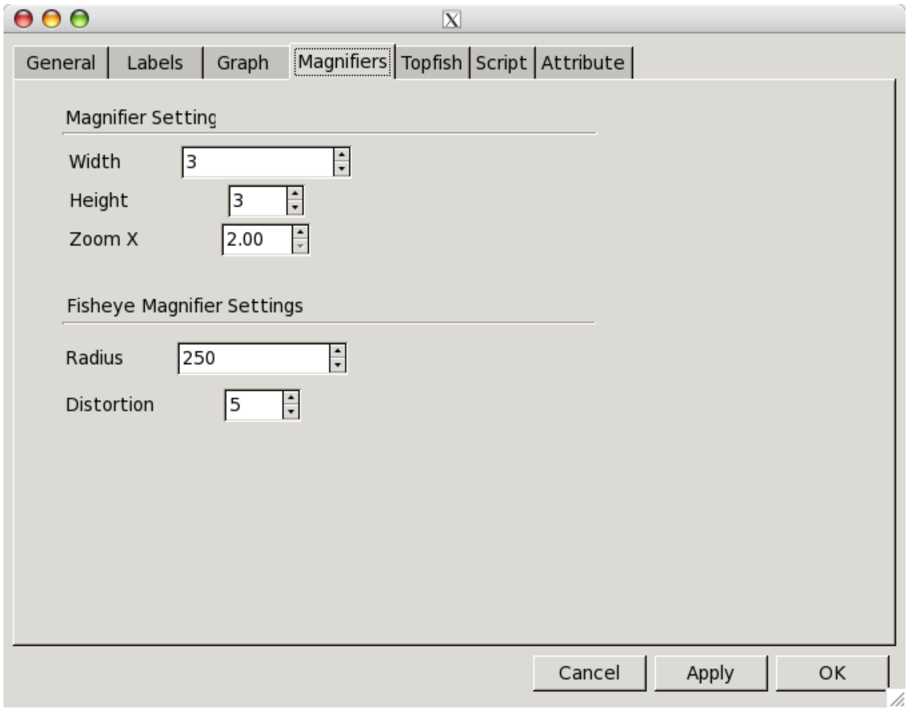
Custom At present, the choice is not implemented.

This tab provides three sliders. The `Node Alpha` and `Edge Alpha` sliders control the transparency of nodes and edges. Set to 1.0, the object is opaque; set to 0, the object is invisible. A typical use would be to set the edge alpha to a small value rather than to turn off edge drawing entirely. The edges would still be visible, but would obscure the drawing as much. These values are multiplied with any alpha valued supplied with an edge's or node's color. The `Node Size` slider can be used to uniformly scale the node size. Note that the node sliders have no effect for custom nodes.

The `Advanced Mode` and `Anti-aliasing` check boxes toggle the advanced user mode and the use of anti-aliasing.

3.1.4 Magnifier Settings

The Magnifiers tab is shown in Figure 6. This controls the magnifying glass parameters. The radius of the fisheye magnifier is specified using the `Radius` field. The `Distortion` field allows you control the distortion in the lens. Larger distortion causes greater magnification.



Magnifier Setting

Width 3

Height 3

Zoom X 2.00

Fisheye Magnifier Settings

Radius 250

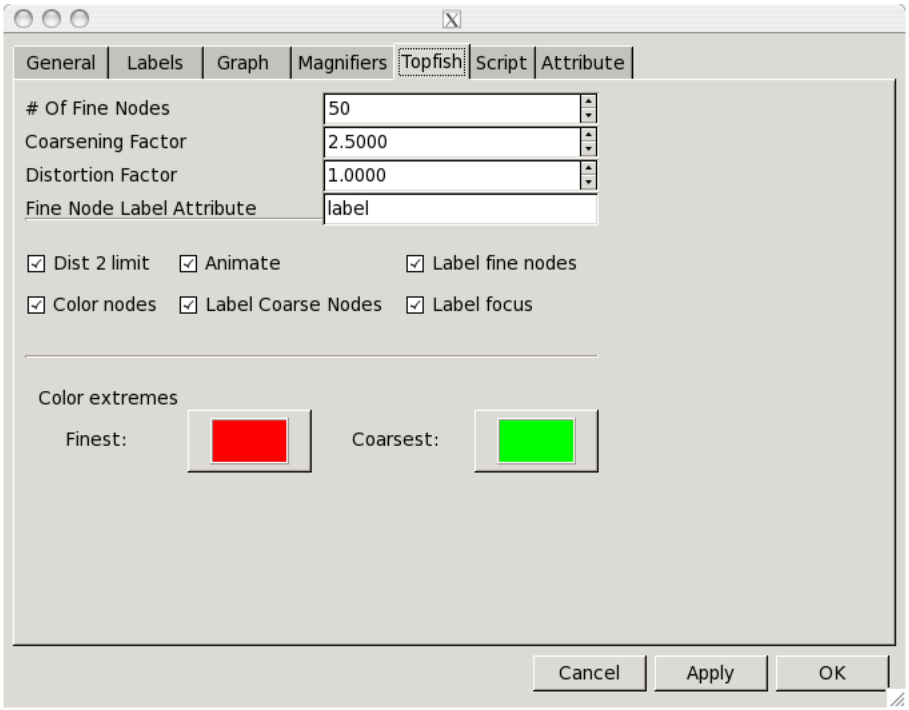
Distortion 5

Figure 6: The Magnifiers tab.

3.1.5 Topfish Settings

The Topfish tab is shown in Figure 7. This allows you to specify the parameters associated with a topological fisheye view of the graph as discussed in Section 2.7. The `# Of Fine Nodes` field allows the user to set the number of the fine nodes The Fine Node Label Attribute indicates what node attribute is used to label fine nodes. The `Coarsening factor` and `Distortion Factor` fields control some technical parameters of the view; refer to the paper for more details.

There are six check boxes.



# Of Fine Nodes	50
Coarsening Factor	2.5000
Distortion Factor	1.0000
Fine Node Label Attribute	label

☑ Dist 2 limit ☑ Animate ☑ Label fine nodes

☑ Color nodes ☑ Label Coarse Nodes ☑ Label focus

Color extremes

Finest: 🟥 Coarsest: 🟩

Figure 7: The Topfish tab.

Dist 2 Limit Distance to limit value of the algorithm **What does this mean?**

Animate Toggles whether animation is used to handle the transition from an old focus to a new focus. Although more expensive, animation helps to preserve the mental map of the graph.

Label Fine Nodes Indicates whether fine nodes are labeled.

Color nodes **What does this do?**

Label Coarse Nodes **What does this do?**

Label Focus Indicates whether the focus node is labeled. The focus node label is displayed prominently whether or not the labeling of fine nodes is enabled.

The two `Color extremes` widgets allow you to set the colors used for the finest and coarsest nodes. Colors of intermediate nodes are interpolated between these two colors.

3.1.6 Applying *gvpr*

The Script tab is shown in Figure 8. This is the main control for using *gvpr* scripts to manipulate the active graph as discussed in Section 2.6. The top text window can be used to enter and edit a *gvpr* script. By then clicking on the `Run gvpr` button, the script is run on the active graph. As usual, to update smyrna's data structures, you will need to click the `Apply` (or `OK`) button, and then click on the main *smyrna* window to cause the the display to be refreshed.

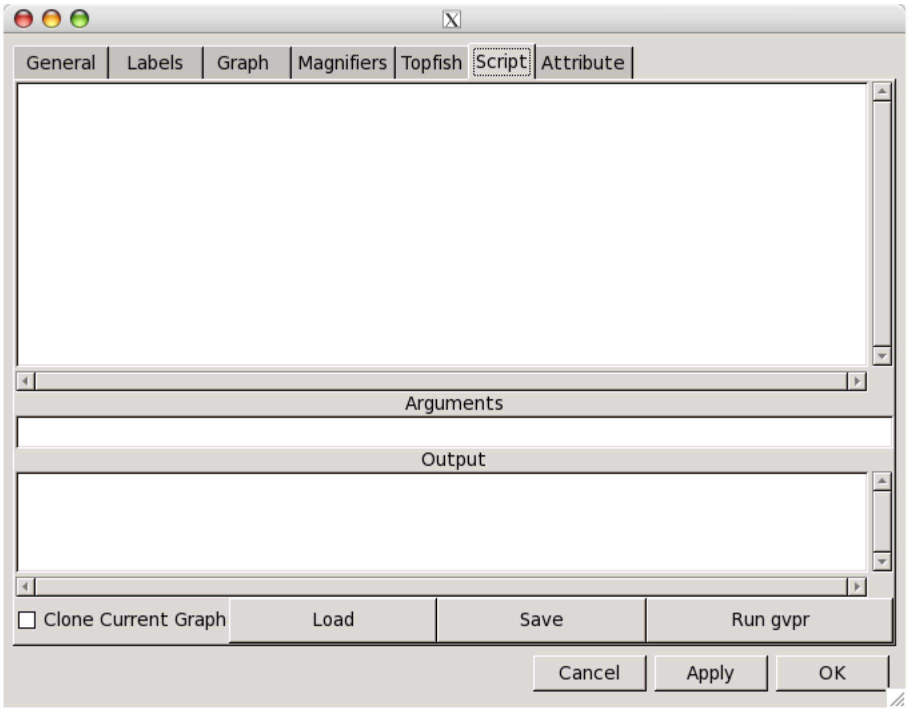


Figure 8: The *gvpr* tab.

By default, any changes are done directly to the active graph. Often, this is appropriate. During exploratory data analysis, though, the user may wish to keep the original graph unaltered in order to return to it later. Rather than trying to undo any changes made, it is simpler to mark the `Clone Current Graph` checkbox. In this case, a clone of the original graph is made. Then, the *gvpr* is applied to the cloned graph, which then becomes the new active graph. The original graph can be retrieved using the `Active Graph` menu at the top of the main *smyrna* window. The obvious drawbacks to this mode are that there is the extra time needed to clone the graph, and the extra memory use for each copy.

A *gvpr* script accepts arguments, which are available via the `ARGV[]` array. Normally, these would be provided on the command line. Here, the user can use the middle `Arguments` text window to supply these.

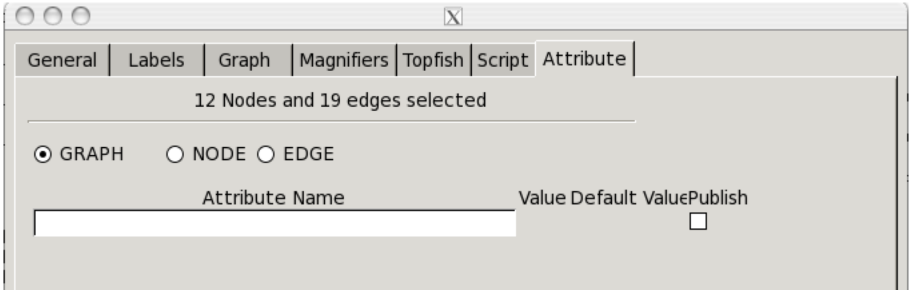
In addition to manipulating a graph, a *gvpr* script can also perform I/O to a `stdout` stream. This output appears in the console window, which is labeled `Output`. The console window opened as part of the main *smyrna* window using the `View` menu is another view of the same stream.

Finally, the `Load` and `Save` buttons support the re-use of *gvpr* scripts. Specifically, the `Load` button can be used to read in a file, whose contents are stored in the *gvpr* script text window, overwriting any previously stored script. Conversely, the `Save` button can be used to write the contents of the script text window into a file for later use.

3.1.7 Setting Attributes

Manipulating attributes is a common task when using *smyrna*. Any such operations can be done using *gvpr*. However, it seems reasonable to support this activity with a simpler interface. The purpose of the Attribute tab is to provide this interface, though it should be noted that the actual work is done using *gvpr*.

Figure 9 shows the initial state when the Attributes tab is opened. Note that the caption indicates that some collection of nodes and edges has been selected. To start, use the radio buttons to specify what type of graph object you wish to work with. Then type in the attribute's name in the `Attribute Name` field. As you type, the tab interface changes dynamically in response to your typing, giving feedback concerning what it knows about available attributes. If what you have typed is the prefix of a known attribute, all attributes with that prefix will appear in



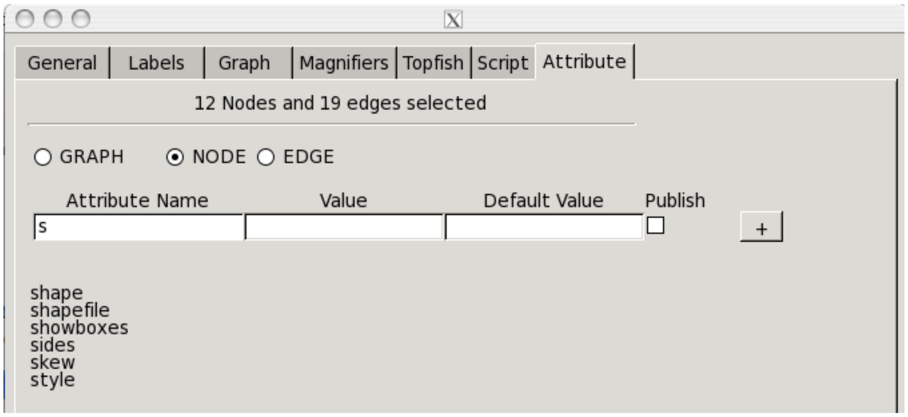
12 Nodes and 19 edges selected

● GRAPH ○ NODE ○ EDGE

Publish ☐

Figure 9: The Attribute tab.

a list below. In Figure 10, the character 's' causes the various known node attributes starting with 's' to be shown.



12 Nodes and 19 edges selected

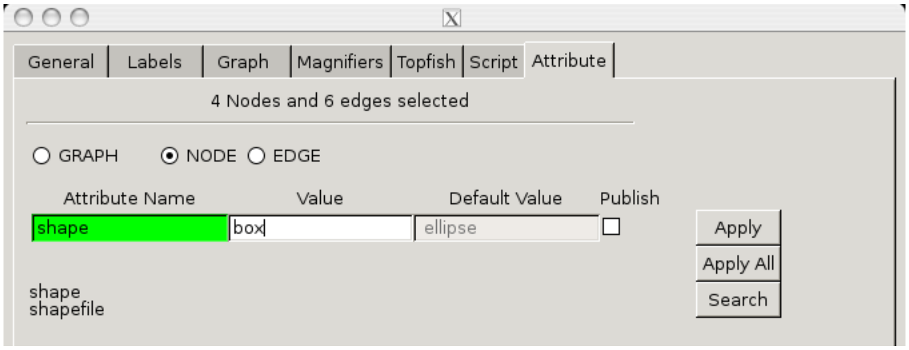
○ GRAPH ● NODE ○ EDGE

Attribute Name	Value	Default Value	Publish
s			☐

shape
shapefile
showboxes
sides
skew
style

Figure 10: Typing in the Attribute tab.

Searching and modifying attributes If the current text fully matches a known attribute, the background color of the `Attribute Name` field will appear in green. In the example shown in Figure 11, the shape attribute has been recognized and the default value is shown. In addition, you will see three additional buttons: `Apply`, `Apply All` and `Search`.



4 Nodes and 6 edges selected

○ GRAPH ● NODE ○ EDGE

Attribute Name	Value	Default Value	Publish
shape	box	ellipse	☐

shape
shapefile

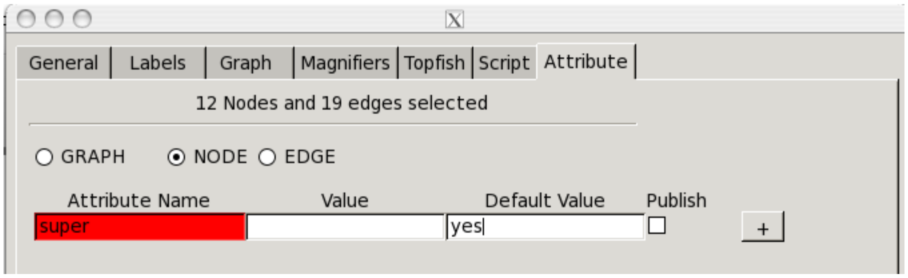
Figure 11: A recognized attribute.

The `Apply` button is used to replace the attribute values of selected objects of the specified object type. In our example, we have chosen the `shape` attribute, and have specified a value of `box` in the Value field. If we then click the `Apply`, *smyrna* will set the shape value of all selected nodes to the given value. Note that if no objects have been selected, the `Apply` button will not be active.

The `Apply All` button is identical to the `Apply` button except that the attribute change is performed on all objects, not just the selected ones.

The `Search` button is used to select objects of the specified object type based on attribute values specified by regular expressions. For example, suppose that you have a network graph with IP addresses attached to each node. You can type `IP` in the attribute name box, `10.*` in the value box, and click on the `Search` button. This will select all nodes whose IP address begins with `10.`. Regular expression matching is, obviously, based on the regular expressions supported in *gvpr*.

Adding new attributes If, as you type, the attribute name is not currently set in the graph for the specified object type, the Attribute Name field will be red and a button with a plus sign ('+') will appear, as in Figure 12. You can then type in a value into the `Default Value` field, click on the '+' button and the appropriate attribute will be created with the given default value, and all objects of the given type that value for the attribute. Here, we have specified a default value of "yes" in the Default Value field. If we now click on the '+' button on the right, *smyrna* will create this new node attribute.



12 Nodes and 19 edges selected

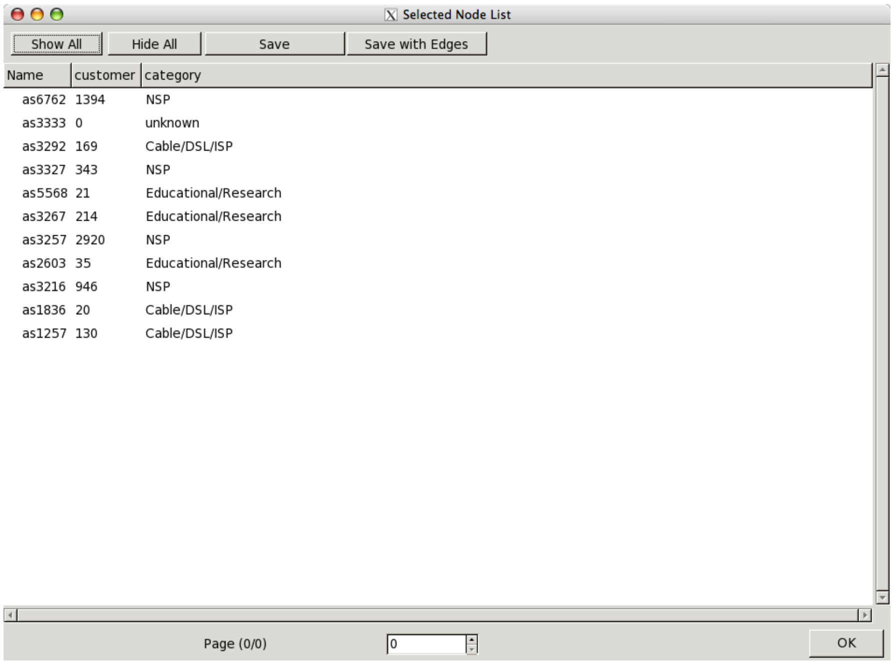
○ GRAPH ● NODE ○ EDGE

Attribute Name: super
Value:
Default Value: yes
Publish ☐

Figure 12: An unknown attribute.

3.2 The Node List Widget

It is often useful to be able to focus on certain nodes, and look at some of their associated attributes. This can be done using *gvpr*(3.1.6), but this type of query is important enough that *smyrna* provides the special-purpose Node List widget. This is opened by using the `Edit` menu. Figure 13 shows a typical view of the widget. It lists all of the currently selected nodes. Selection could have been down by clicking on the nodes, sweeping out a region, or via *gvpr*. The list always gives the names of the selected nodes. You can specify additional attributes to be displayed by setting the graph's `datacolumns` attribute, which is a comma-separated list of the desired attribute names. Thus, in the example shown, the graph has `datacolumns="category,customer"`. To select new columns, just run *gvpr*. For example, to switch the current two columns and add the `tier` attribute, you would run the *gvpr* script



Name	customer	category
as6762	1394	NSP
as3333	0	unknown
as3292	169	Cable/DSL/ISP
as3327	343	NSP
as5568	21	Educational/Research
as3267	214	Educational/Research
as3257	2920	NSP
as2603	35	Educational/Research
as3216	946	NSP
as1836	20	Cable/DSL/ISP
as1257	130	Cable/DSL/ISP

Figure 13: The Node List widget.

```
BEG_G{datacolumns="customer,category,tier"}
```

Note that, at present, you will need to close and then re-open the Node List widget to get the new columns.

The widget provides four buttons that can sometimes be useful in this context. The subgraph may be interesting enough that you wish to view it off-line. By clicking the `Save` button, you can save the nodes as a separate graph. The `Save` `with Edges` button, the graph saved with the selected nodes and all edges in the original graph between two selected nodes. The `Hide All` button will make all of the selected nodes invisible; the `Show All` button makes them all visible.

4 *smyrna* Attributes

This section describes the various attributes used to control how *smyrna* works. Unless otherwise noted, all attributes belong to the root graph.

The following table lists the principal attributes used by *smyrna*.

Name	**Description**	**Default**
bgcolor	Background color	white (#ffffff)
bordercolor	Border color	#38eb29
bordervisible	Draw graph border (boolean)	1
gridcolor	Grid color	#6033d8
gridsize	Grid size	30
gridvisible	Draw grid (boolean)	0
defaultlinewidth	Default line width	1
selectednodecolor	Color of selected nodes	#8ce61d
selectededgecolor	Color of selected edges	#ffc0cb
usermode	Advanced mode (boolean)	1
drawnodes	Draw nodes (boolean)	1
drawedges	Draw edges (boolean)	1
drawlabels	Show node labels (boolean)	1
defaultnodealpha	Overall alpha scale for all nodes. This value is multiplied by a node's alpha value.	0.8
defaultedgealpha	Overall alpha scale for all edges	0.5
defaultnodeshape	OpenGL dots (0); spheres (1); custom (2)	0
labelglutfont	Glut font id to use to render labels	0
nodelabelcolor	node label color	#8ce61d
edgelabelcolor	edge label color	#8ce61d
nodelabelattribute	Node attribute used as node label	name
edgelabelattribute	Edge attribute used as edge label	name
labelwithdegree	Labels of high-degree nodes with rendered before the ones with lower degree (boolean)	0
labelnumberofnodes	Maximum number of node labels to be rendered	45
shownodelabels	Show node labels (boolean)	1
showedgelabels	Show edge labels (boolean)	1
colortheme	Color theme id for edges with no color attribute. If unset, color is based on edge length; if set, edgecolorattribute is used	1
defaultnodecolor	Default node color	blue
defaultedgecolor	Color of edges with no color attribute. Active only when colortheme attribute is set to "-1"	purple
edgecolorattribute	Set this attribute when you need a different value other than edge length to calculate color themes for edges	
nodesize	Overall node size scale	50
nodesselectable	Enable visual selection tools for nodes	1
edgesselectable	Enable visual selection tools for edges	1

Most of these attributes are self-explanatory.

4.1 usermode

What does this attribute do?

4.2 fonts

Explain font ids

4.3 colors

Explain color theme ids, default node and edge colors and edgecolorattribute

4.4 labels

name as pseudo-attribute
labelwithdegree labelnumberofnodes

4.5 alpha values

Explain defaultedgealpha defaultnodealpha

4.6 Node shapes

The node shape attribute determines the look, flexibility and performance associated with how nodes are displayed. If `defaultnodeshape` is set to 0, *smyrna* uses OpenGL dots. This gives the best performance, but does not allow variations in size. A value of 1 causes *smyrna* to use spherical node shapes. For large graphs, this will cause some slowdown when panning and zooming. On the other hand, one can set the size of each node individually via a node's `size` attribute. Finally, if 2 is used, *smyrna* will draw nothing.

This table lists the attributes used by *smyrna*in the topological fisheye mode.

Name	**Description**	**Default**
topologicalfisheyefinenodes	Number of the fine nodes in topological fisheye view	50
topologicalfisheyecoarseningfactor	Coarsening factor of topological fisheye	2.5
topologicalfisheyedistortionfactor	Distortion Factor	1
topologicalfisheyeanimate	Animate transitions (boolean)	1
topologicalfisheyelabelfinenodes	Show fine node labels	1
topologicalfisheyecolornodes	Color nodes (boolean)	1
topologicalfisheyelabelfocus	Show focus node labels (boolean)	1
topologicalfisheyefinestcolor	Color of fine nodes	red
topologicalfisheyecoarsestcolor	Color of coarse nodes	green

The following attributes affect the magnifying glass widget.

Name	**Description**	**Default**
defaultfisheyemagnifierradius	Radius of magnifier glass	350
defaultfisheyemagnifierdistort	Distortion value of magnifying glass	5

The larger the distortion, the larger the magnification factor.

4.7 Node and Edge Attributes

At present, it is assumed that the input graph has been laid out. In particular, each node should have a `pos` attribute specifying 2 or 3 real numbers giving the x and y and, if applicable, z coordinates of the node.

edge pos If an edge does not possess a `pos` attribute, the edge will be drawn as a line segment connect its end vertices.

If a node or edge has a `color` attribute, that will be used as its color. Similarly, a node may have a `size` attribute, which will affect the node's size if `defaultnodeshape == 1`.

If a node or edge has a `visible` attribute, that will be used to determine whether to draw the object or not. By default, the object is drawn. To make an object invisible, set `visible = 0`.

smyrna also checks for a `_draw_` attribute for nodes, edges and graphs. This is assumed to be a valid xdot string describing how to render the object. If the graph has a `_draw_` attribute, this will be drawn first to serve as a background for the node and edges of the graph.

A Modifying the *smyrna* GUI

Explain attrs.txt and attr_widgets.dot and mouse_actions.txt

Note template.dot

References

[GKN05] E. R. Gansner, Y. Koren, and S. North. Topological fisheye views for visualizing large graphs. *IEEE Transactions on Visualization and Computer Graphics*, 11:457–468, 2005.